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Making Malleable Cast Iron Rifle Grenades

How a Daily Average Production of 25,000 of These Castings Was Attained and How the Foundry Was Built and First Grenades Poured in 83 Days

FOR many generations the hand grenade has been counted among the foremost destructive weapons of war, but it is in grave danger of having its ranking position wrested away by the rifle grenade now employed extensively by the hostile forces intrenched on the European battlefields. Although introduced only in comparatively recent years, inventive genius has developed nearly as many varieties of the rifle as of the hand type of grenade. The strong arm of the grenadier, however, cannot compete with a gun in imparting propelling power to this instrument of warfare and it is because of its greater range of effectiveness that this new missile is in such high favor among the occupants of the trenches.

Furthermore, the hand grenade is an exceedingly dangerous weapon, even in the hands of the most skilled soldier. Unless thrown within a few seconds

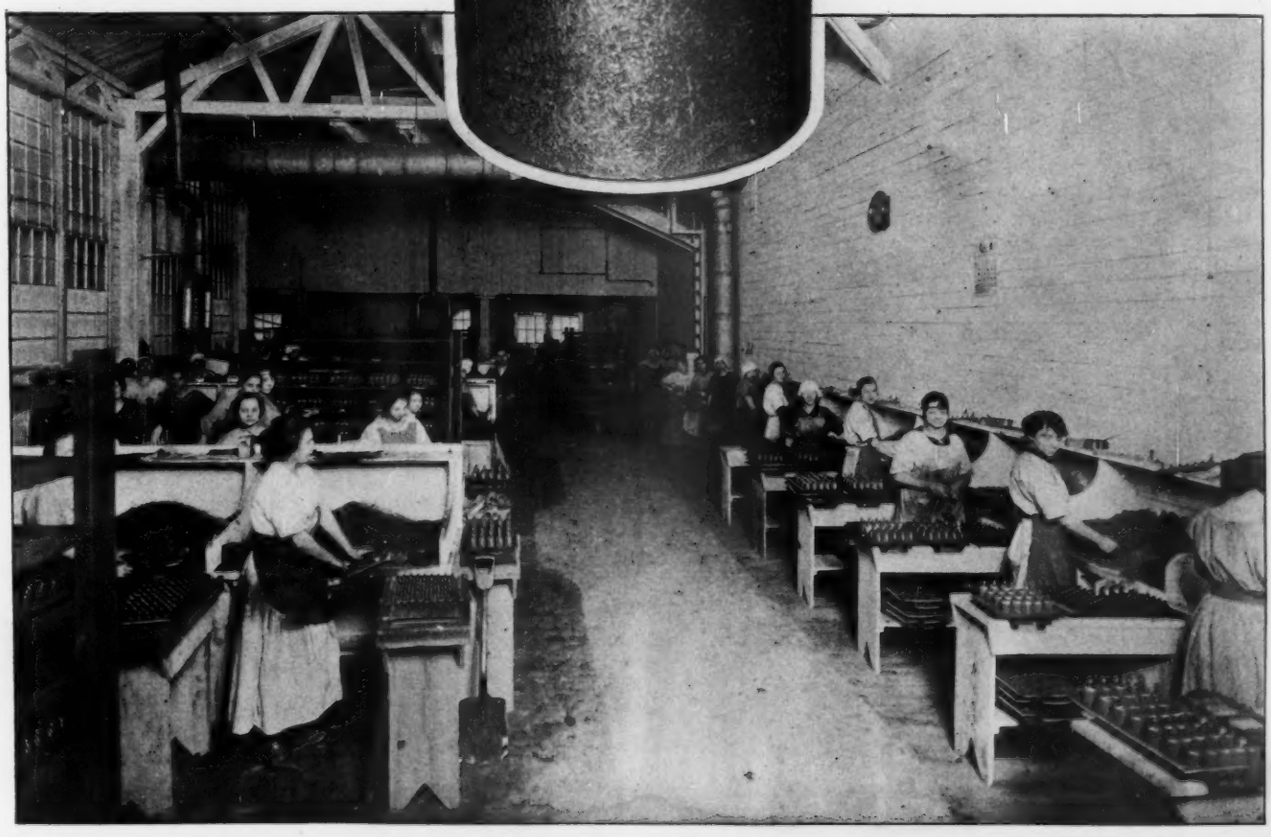


FIG. 1—MALLEABLE IRON RIFLE GRENADE THAT SOON WILL BE ON ITS WAY INTO THE GERMAN TRENCHES.
FIG. 2—A CONTENTED FORCE OF AMAZONS DOING THEIR BIT MAKING CORES FOR RIFLE GRENADES

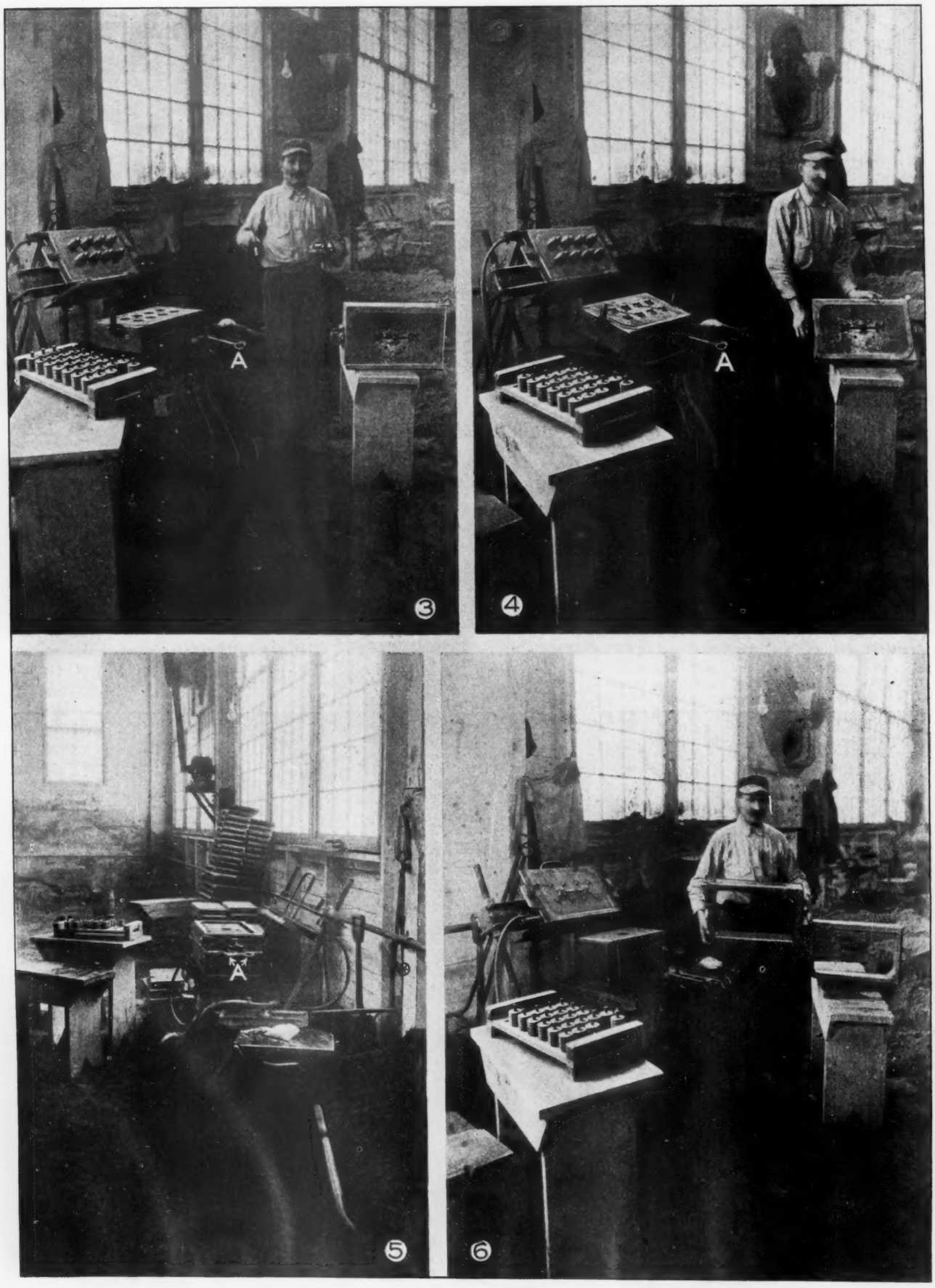


FIG. 3—RIFLE GRENADES ARE MOLDED ON POWER SQUEEZERS. THIS ILLUSTRATION SHOWS THE DRAG ON THE MACHINE, WITH THE DRAG PLATE AND THE COPE ON THE BENCH. FIG. 4—IN THIS VIEW THE CORES HAVE BEEN PLACED IN THE DRAG. FIG. 5—MOLD CLOSED AND VENT WIRES *A* BEING WITHDRAWN. FIG. 6—SNAP FLASK REMOVED. COPE HALF OF MATCHPLATE IS SHOWN

FIG. 7—ROLL-OVER DEVICE THAT TRANSFERS THE GRENADE CORES FROM THE DRYERS TO WOODEN TRAYS FOR DELIVERY TO THE MOLDERS. A RACK LOADED WITH CORES IS SHOWN ENTERING THE OVEN

after the fuse is lighted or the trigger set, it is liable to explode in the hands of the grenadier and the list of casualties from this cause in this war is known to be heavy. By employing the rifle as the propelling medium, using either the bullet to set the trigger or some other means for discharging the explosive, this danger is almost entirely eliminated.

Immediately following the declaration of war by the United States, experiments were made with different kinds of rifle grenades to ascertain their effectiveness and destructive power. Hand grenades generally are made of cast iron and are nearly of as many different designs as the number of

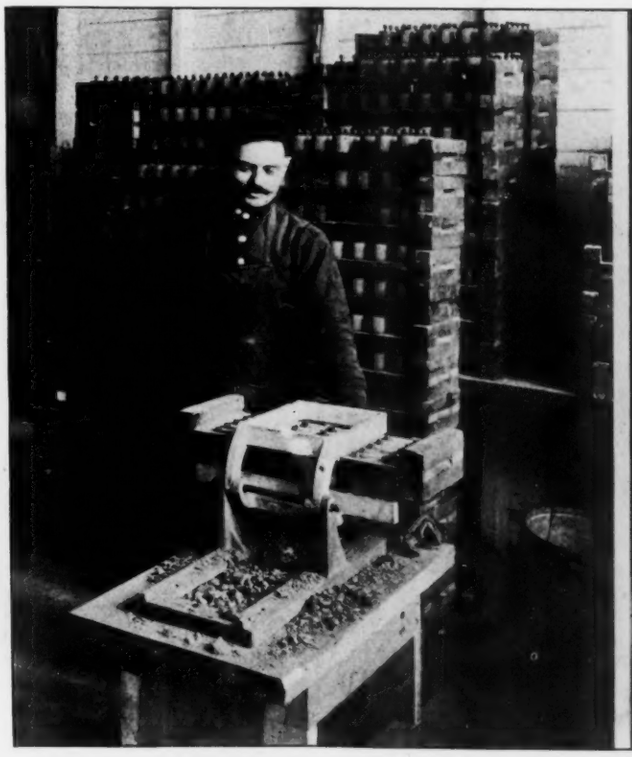


FIG. 8—THE CORE DRYER AND TRAY JUST BEFORE ROLLING OVER

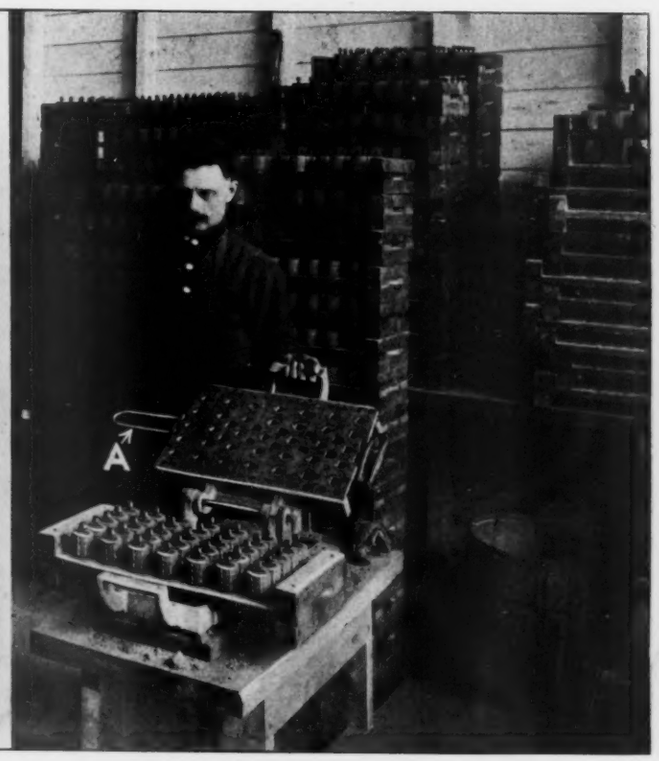


FIG. 9—CORES DEPOSITED ON WOODEN TRAY AND DRYER SWUNG BACK

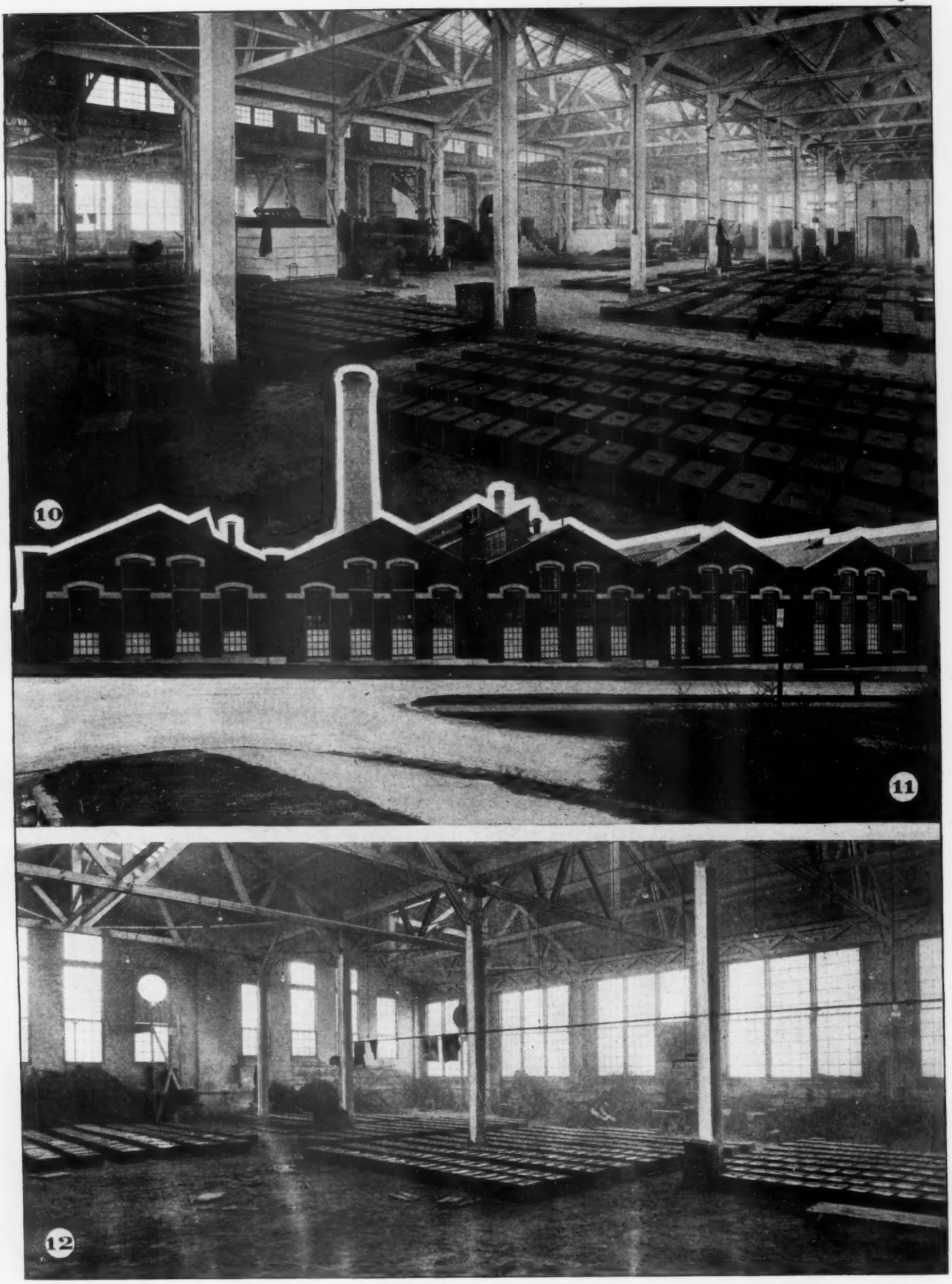


FIG. 10—SOME OF THE FLOORS AT 11:30 A. M. THIS VIEW INDICATES THAT THE FOUNDRY IS WELL-LIGHTED. FIG. 11—FRONT OF THE FOUNDRY SHOWING ROOF CONSTRUCTION. FIG. 12—ANOTHER VIEW OF SOME OF THE FLOORS AT 11:35 A. M.

countries at war. The shattering of the grenade is facilitated by its corrugations, either on the outside or inside, and it is the aim of ordnance experts to have it break into as many destructive pieces as possible, by its contained explosive. Neither cast iron nor cast steel proved a desirable metal for the rifle grenade. When made of gray iron, the explosive reduced the grenade to powder, whereas cast steel proved to be too resistant and unyielding. Malleable iron was finally resorted to and was found to possess the desirable shattering properties for this purpose. Malleable grenades, in different tests, have been broken into 100 or more pieces of destructive effectiveness and this metal now is being used in rifle grenade manufacture.

The Westinghouse Electric & Mfg. Co., Pittsburgh, was awarded one of the first orders placed for rifle grenades, and not having a malleable cast iron foundry, it became necessary to erect one immediately. It was decided to build it at Cleveland on a side adjoining the Westinghouse gray iron plant in that city. The period intervening between the placing of the contract and the date of first delivery of rifle grenades was spanned by only a few months. The burden of this stupendous undertaking was placed upon Benj. D. Fuller, superintendent of the Cleveland foundry of the Westinghouse company and his assistant, C. F. Knowlton, and how well they performed their task is best reflected by a record of 83 days from the time ground was broken until the first grenades were cast. The foundry building and the melting furnace were designed and erected under the supervision of Bernard H. Prack, Pittsburgh, and to him and other contractors much credit is due for having expedited the work. Before excavations could be made, 12,000 cubic yards of earth had to be removed. This work was started Sept. 14, last year, and the first run of the furnace was made on Nov. 22. Four days later, namely, Nov. 26, the first grenades were cast. The contract specifies the delivery of 25,000 daily and an average in excess of this amount has been maintained since the first heat was made.

As illustrated in Fig. 1, these grenade castings are cylindrical in form, cored out inside, with small openings top and bottom for the passage of the rifle bullet, which sets the trigger for discharge. The casting weighs only 15 ounces, is corrugated inside, as shown in Fig. 13, and is only 3/16-inch thick, which is reduced to ⅛-inch at the corrugations. The discharge of the bullet from the rifle propels the grenade which may be fired a distance of 300 yards.

The grade of the malleable cast iron from which these rifle grenades are being produced is illustrated in Fig. 13. The wedge, *B*, satisfactorily passed the bending test and the fractures, *A* and *C*, clearly defined the black heart and the gradual shading from the white to the gray and to the black center. A grenade that was subjected to repeated blows by a heavy sledge is shown at *D* and the fractured pieces of another grenade, at *E* and *F*. These also outline clearly the regularity of the corrugations inside of the grenade casting. Tests of the iron from which these grenades are made have developed a tensile strength of 42,500 pounds per square inch and an elongation of 5.5 per cent.

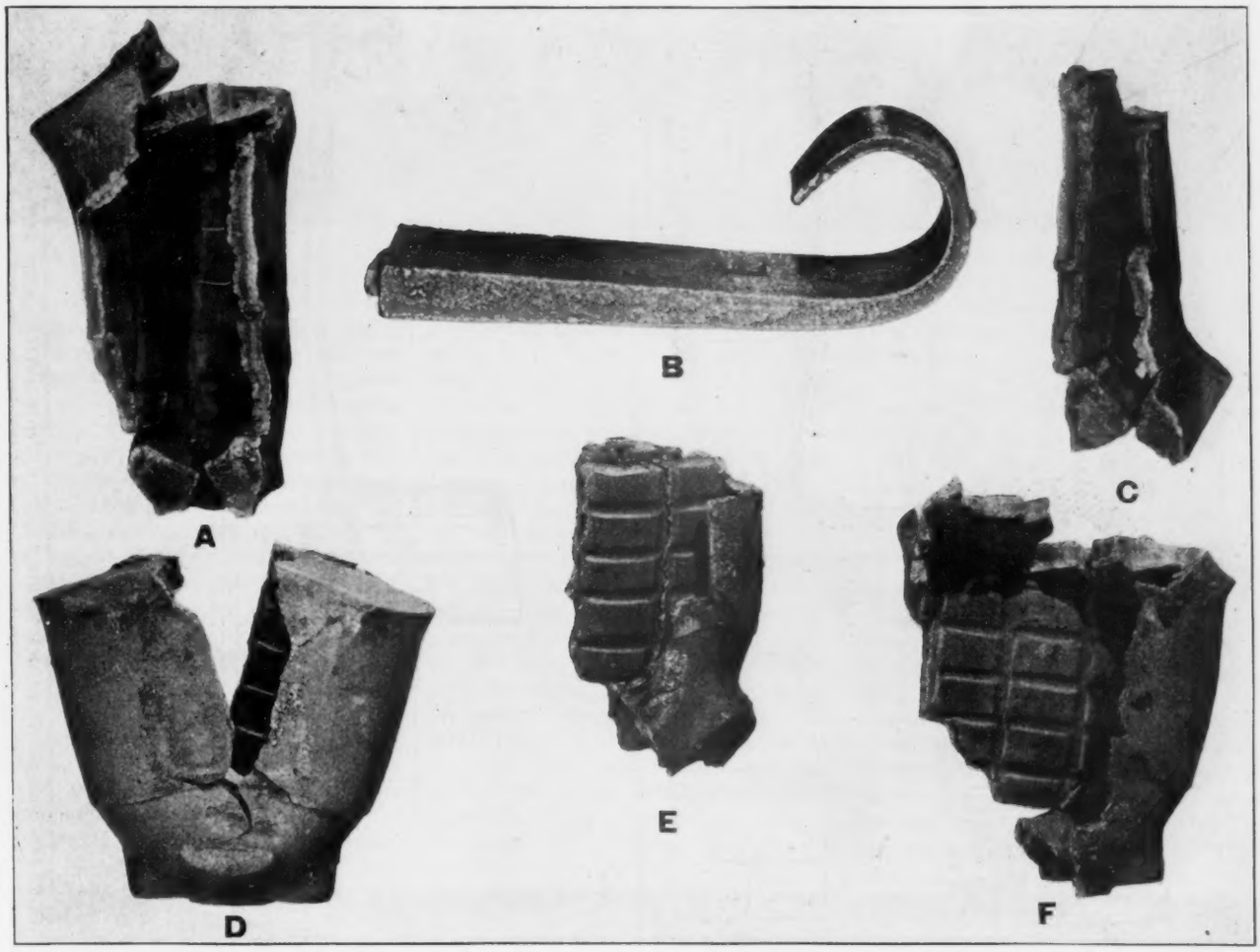


FIG. 13—THAT THE RIFLE GRENADES ARE MADE OF TOUGH MATERIAL IS INDICATED BY THESE SPECIMENS
The clearly defined fracture with its black heart is shown at *A* and *C*; *B* is one of the test wedges; a grenade after being subjected to repeated blows by a sledge is shown at *D*; and *E* and *F* are broken specimens that reveal the regularity of the inside corrugations

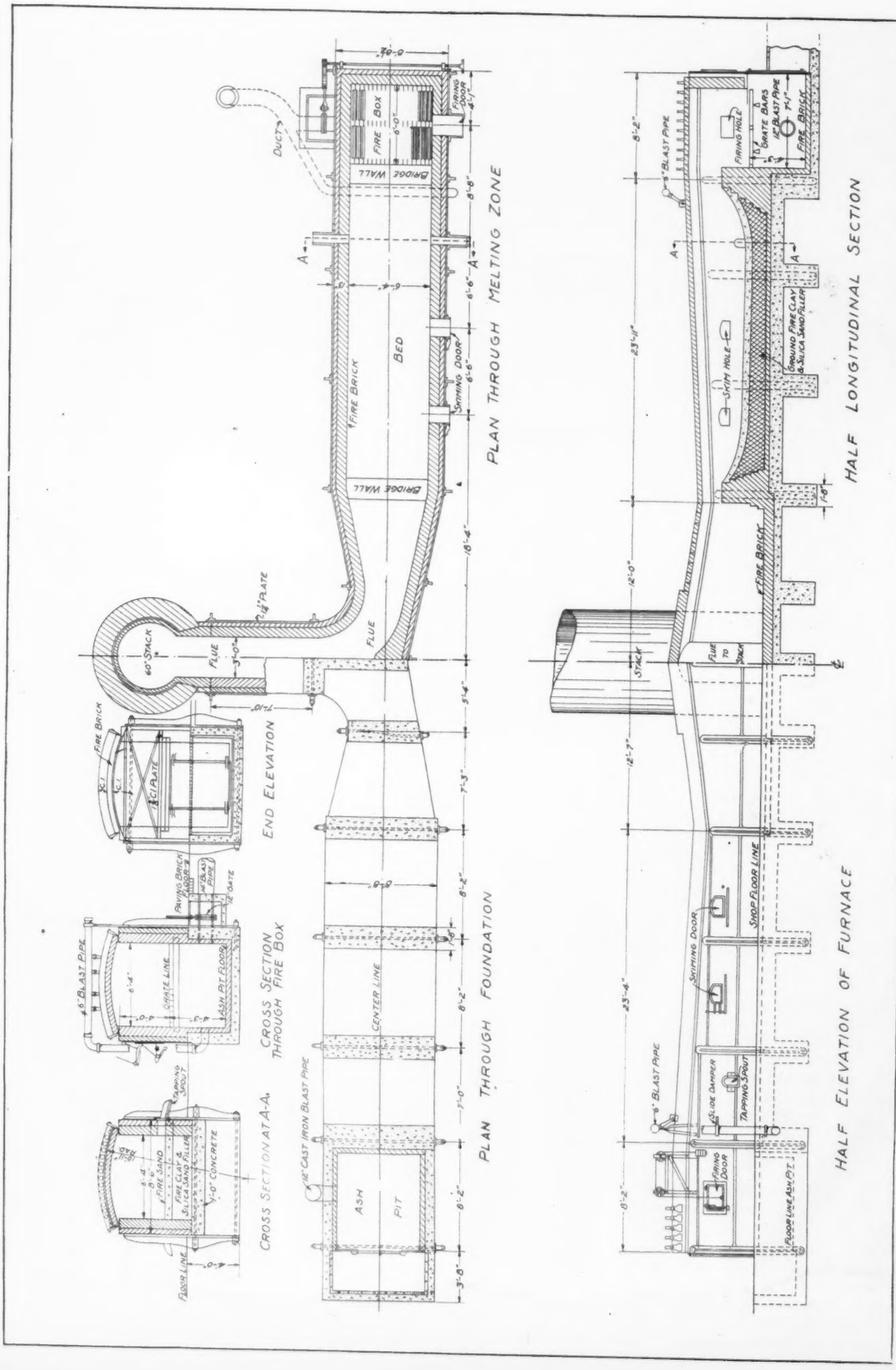


FIG. 14—DETAILS OF CONSTRUCTION OF THE AIR FURNACE SHOWING PLANS THROUGH THE FOUNDATION AND THE MELTING ZONE, HALF ELEVATION AND HALF LONGITUDINAL SECTIONS THROUGH THE FURNACE

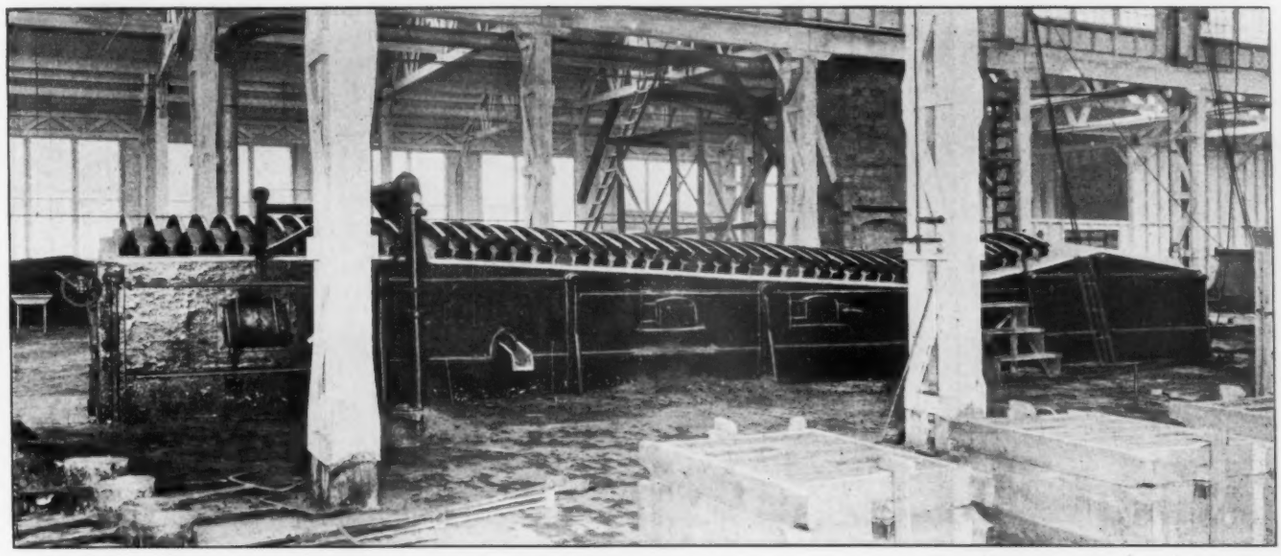


FIG. 15—THE AIR FURNACE, SHOWING TAPPING SPOUT AND SKIMMING DOORS

Floors of 200 molds for a day's output not only reflect the driving power of the operator, but also the efficiency of the mechanical molding equipment and the ingenuity of the special rigging provided. The grenades are molded, eight in a flask, on air-operated squeezers. Twenty-one of these machines have been installed by the Osborn Mfg. Co., Cleveland, and an additional battery of five has been ordered. The squeezers are arranged around the walls and near the center of the shop, in positions which afford light at the proper angle. Aluminum matchplates, with cope and drag pattern on either side, have been provided, the entire mold being made in one operation. The cores are delivered to the operators on wooden trays and a sufficient supply is kept on hand constantly to prevent delays.

In Fig. 3 is shown one of the power squeezers, with the drag on the machine. The cope which has been lifted off is on a bench at the right. The drag side of the matchplate also is illustrated. In Fig. 4 the cores have been placed in the mold and the operator is preparing to close-over the cope. The mold has been closed in Fig. 5 and wires for venting each of the cores are withdrawn before removing the snap flasks, Fig. 6. These vent wires are shown at *A* in Figs. 3, 4 and 5 and are lying on the table of the machine in Fig. 6. To vent these cores by the usual method would require eight operations, but this simple device has reduced the venting to one. The wires are passed through openings in the cope flask and passing over the tops of each of the eight cores, provide vents that extend through the sides of the mold. The wires are properly directed by the openings in the flask and when withdrawn form perfect vents for the cores.

The cope half of the matchplate is shown in Fig. 6, and the size and direction of the gates is clearly defined. The depth of the gates also is illustrated in Figs. 3 and 4, showing the cope halves of the mold. A part of the gate thickness also is carried by the drag, but the greatest thickness is in the cope. These gates represent a large percentage of the foundry remelt, but their size is essential because of the high shrinkage of the metal. It will be noted that the grenades are molded on end, instead of on their sides when they would be split longitudinally. The entire pattern is carried in the drag, only the top print of the core being in the cope. Molding the grenade in

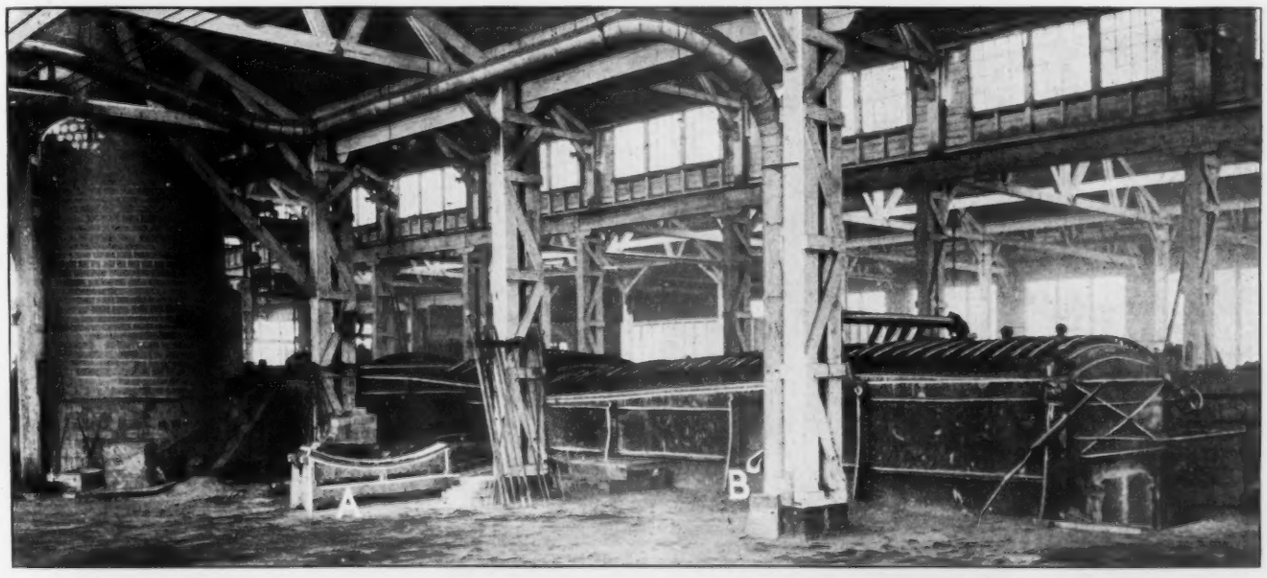
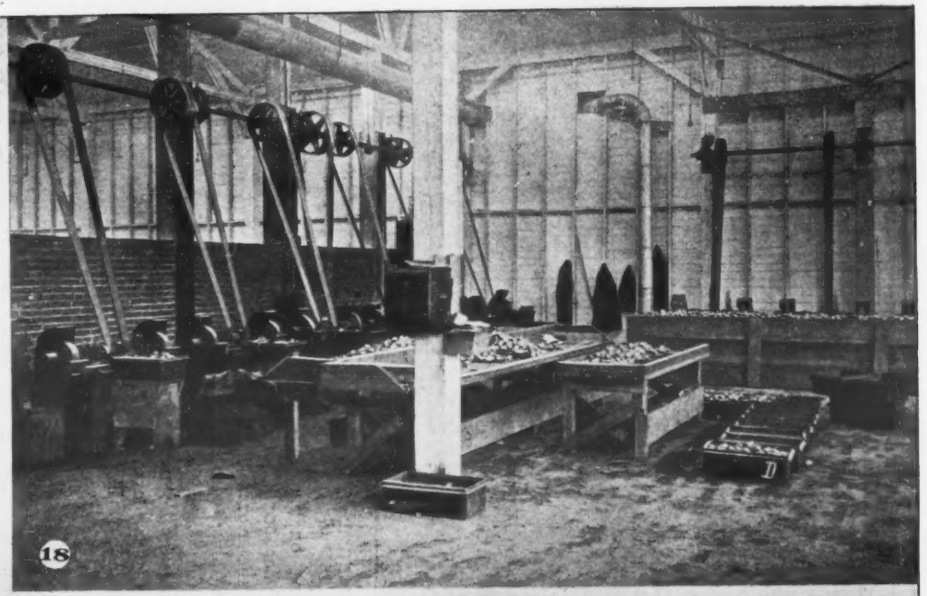
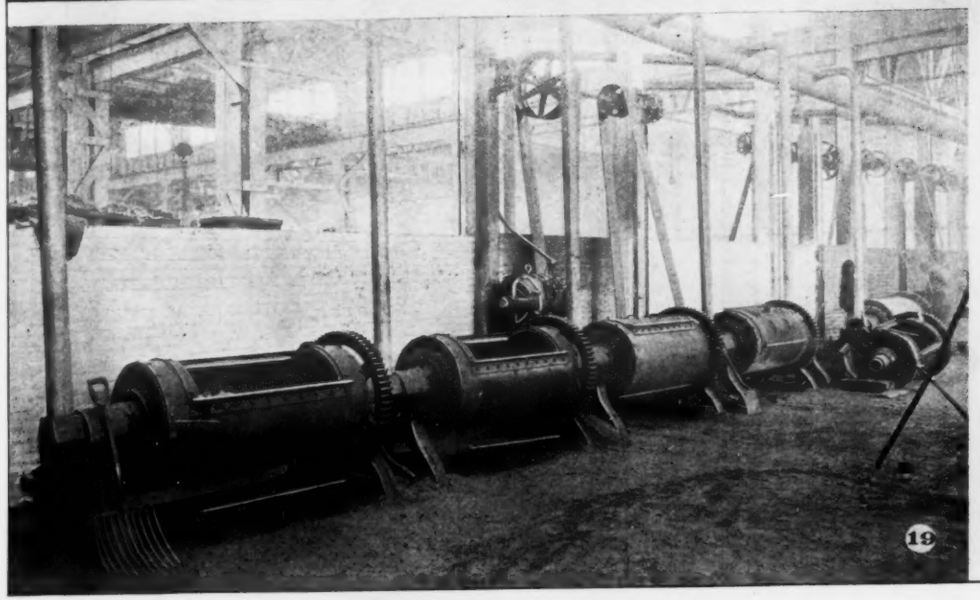


FIG. 16—STACK SIDE OF AIR FURNACE SHOWING A CRADLE AT *A* TO FACILITATE RELINING THE BUNGS AND A TAPPING SPOUT AT *B*





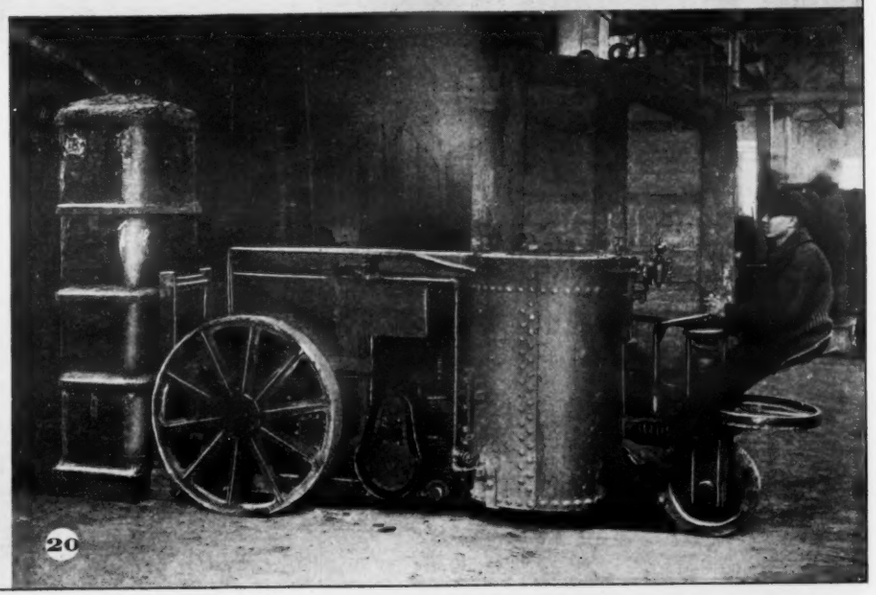


FIG. 17—THE FOUR MILLS FOR TUMBLING THE GRENADES IN THE HARD. FIG. 18—WHERE THE GRENADES ARE GROUND AND INSPECTED BEFORE SHIPMENT.
FIG. 19—MILLS FOR TUMBLING THE CASTINGS AFTER ANNEALING. FIG. 20—THE STEAM-DRIVEN ANNEALING FURNACE CHARGING MACHINE

FIG. 21—TWO BATTERIES OF FOUR OVENS FOR ANNEALING THE GRENADES

its vertical position makes it possible to center the core accurately and prevents it from shifting which may occur when molded on its side with a greater surface exposed to the lifting action of the metal. The entire operation of molding has been reduced to simplicity by the care exercised in selecting the equipment and in designing the rigging. The prints in both cope and drag are ample to insure the proper centering of the core without adjustment by the operator. The sand is prepared for the molders by a sand cutter furnished by the Sand Mixing Machine Co., New York. Figs. 10 and 12 clearly illustrate the arrangement of the molding floors and the wonderful progress of the day's work at about 11:30 a. m., when these views were taken. At this hour one operator had put up 140 molds and another, 125. The record, up to the present time, is 200 for a day's output and with further experience the high mark soon will pass this figure. An output of 200 molds involves the setting of 1600 cores, each one of which must be placed with care. Producing the necessary core for a minimum output of 25,000 sound rifle grenade castings per day requires organization. This involves not only the personnel of the working force, but every facility to expedite operations. Although the cores themselves are made by hand, much ingenuity has been displayed in the design and construction of the core boxes and other devices, that are wonderful aids in the attainment of an output of 36,000 cores daily. Women coremakers only are employed, the force at present consisting of 42. The interior of the core room is shown in Fig. 2 and a striking feature of this department is its cleanliness. The white walls and roof reflect an ample flood of daylight and only on the darkest days is it necessary to resort to artificial illumination. The core room is in a building detached from the other departments. It is provided with a separate entrance which obviates the necessity of the coremakers passing through other parts of the plant to their place of employment. On a mezzanine floor at one end of the building are the rest and lunch rooms and the only male employes who have access to this department are the men who truck the racks to the core ovens. The latter are located in an adjoining room, separated from the core department by a partition which excludes the gases and smoke from the baking of the cores. A simple but effective device has been provided for removing the baked cores from the dryers to wooden racks on which they are delivered to the molders. To handle each core

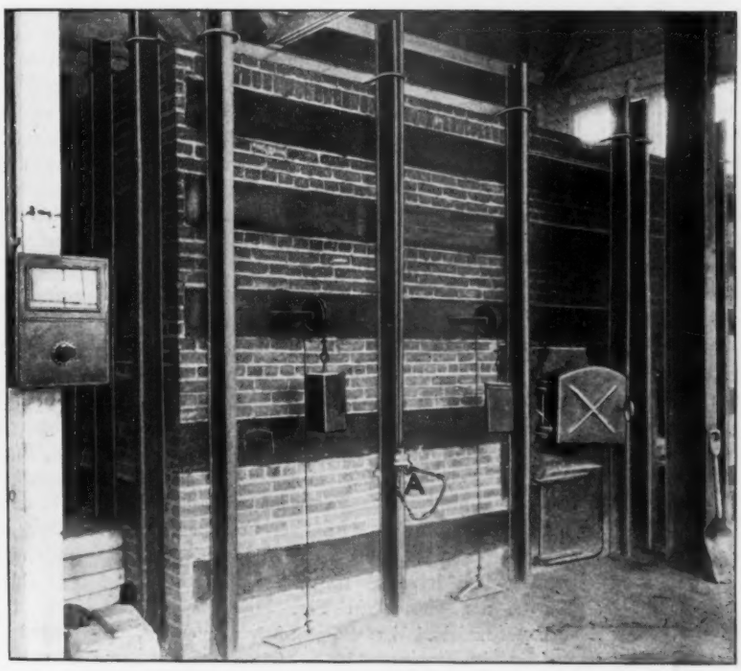


FIG. 22—THE TEMPERATURES OF THE OVENS ARE INDICATED BY PYROMETER, TWO THERMO-COUPLES BEING ATTACHED TO EACH FURNACE

would not only require the employment of four or five men, but the loss through breakage would be a serious item. By the use of the roll-over device, illustrated in Figs. 7, 8 and 9, one man now performs this work without handling a single core and the loss from breakage is so small that it is barely recognizable. Each dryer holds five cores and seven dryers are placed on a frame, as illustrated in Fig. 9. Handles are provided on either end of the frame to permit of the easy removal of the cores from the rack. Each tray holds 35 cores.

Rolling-over the Cores

When the tray of cores is removed from the rack it is set on one of the cradles of the roll-over device. As the dryers are not held together on the tray, a U-shaped wire, *A*, Fig. 9, is passed through holes in ribs on the bottom of the dryers thereby fastening all of the dryers together. The wire also passes through holes in the ends of the tray or frame, thereby fastening the dryers to the tray. The wooden tray on which the cores are delivered to the machine operator then is set upon the cores, being perforated for the lower print extension. In Fig. 7 the wooden tray is shown clearly and in Fig. 8 the other cradle has been rolled-over. By grasping the handles of the cradles the parts are lightly clamped together and turned over, as illustrated in Fig. 9. The cradle containing the tray of dryers then is rolled back, being securely fastened to the cradle. Before lifting off the tray the U-wire is withdrawn and the tray of dryers is replaced on the rack for return to the core room.

The cores are made in two parts, one of the neck and print extensions being pasted on. The body of the core hollows out the inside of the grenade and also makes the corrugations. Necks on either end of the body core make the top and bottom openings in the grenade and the cone-shaped extensions on the necks of the core fit into the cope and drag halves of the mold, centering the core and preventing it from shifting.

The racks on which the cores are dried are of steel angle and cast iron construction. Each shelf has a capacity of 10 trays, or 350 cores, and the eight shelves therefore carry 2800 cores. The cores are baked in about 20 minutes at temperatures of approximately 350 to 400 degrees Fahr. The racks are lifted and conveyed by trucks, built by the Cowan Truck Co., Holyoke, Mass., which have proved unusually satisfactory for this purpose. A battery of four oil-fired ovens has been installed, three of which are used for baking cores while the fourth is employed for heating ladles. Sand for the cores is prepared in a mixer furnished by the Blystone Mfg. Co., Cambridge Springs, Pa. This machine is installed in one end of the core room.

Although only one melting furnace has been provided, space has been left for a second unit, which is now being built. The flue to the stack and the stack were designed for two furnaces. Details of the furnace are illustrated in Fig. 14, which shows plans through the foundation and melting zone, and half elevation and longitudinal sections. It is designed to melt 15 tons per heat, although 19½ tons have been tapped out on several occasions. The overall length is 44 feet 1 inch, and the metal is tapped out on both sides. Being located in the center of the shop this greatly reduces the distance that the metal has to be carried. The blast is directed onto the flame through a 6-inch blast pipe and the bridge walls are 3 feet 3 inches high. As indicated by Fig. 14, the furnace is unusually well stayed. The flue leading to the stack is 3 feet wide and 5 feet 6 inches high, while the stack has a base diameter of 5 feet and is 80 feet high. Fig. 15 is a view of the skimming side and shows one of the tapping spouts; Fig. 16 shows the opposite side with a tapping spout at *B*. A frame for supporting the bungs while relining is shown at *A*. The sides of this frame are curved to conform to the contour of the bung and the edges of the brick are lined up to this frame. The work of relining is expedited by the frame and all brick are in alignment on the edges.

In the production of malleable cast iron, two cleaning operations are necessary. The castings first have the adhering sand and the cores removed while still in the white hard condition and they are tumbled again after their removal from the annealing pots. Four large exhaust, motor-driven tumbling mills, Fig. 17, clean the castings in the hard, and six mills of a smaller diameter, Fig. 19, tumble the grenades after they have been annealed. All of the mills are equipped with exhausts that prevent the accumulation of dust which is delivered to an arrester located outside of the building. The dust collector is of the Morse rarefied type, built by the Knickerbocker Co., Jackson, Mich., and the tumbling mills were installed by the W. W. Sly Mfg. Co., Cleveland. The two batteries of double grinding stands, belt-driven from motor-operated shafts, are shown in Fig. 18. These were furnished by the Safety Emery Wheel Co., Springfield, O. After grinding, the castings are inspected and are ready for shipment.

The grenades are annealed in two batteries of four ovens, Fig. 21. These are coal-fired from the rear, Fig. 22, the temperature being controlled by a thermo-electric pyrometer installed by the Haskins Mfg. Co., Detroit. The temperature is taken at two points in each furnace, namely at the back, as shown at *A*, Fig. 22, and on one side near the front. The castings are annealed at a temperature of about 1700 degrees Fahr., being held at this point for 60 hours. This temperature is attained in about 12 hours and 24 hours are required for cooling, the entire annealing operation consuming 96 hours, or four days. Four pots constitute a stack, each pot holding about 490 castings and each oven 55,000, or slightly in excess of two days' output. Since the molding capacity is greater than that of the annealing ovens, two additional ovens will be built. A steam-driven charging machine, Fig. 20, furnished by the Jewell Steel & Malleable Co., Buffalo, is employed for placing the stacks in the ovens and for discharging them when the castings are annealed. The annealing department floor is wood block and is commanded by pillar trolleys equipped with air hoists of the Ingersoll-Rand type for stacking and lifting off the pots.

How the Foundry is Laid Out

The foundry is a brick and wood, heavy mill type structure, 165 x 242 feet, designed and built by Bernard H. Prack, Pittsburgh. It is located south of the other Westinghouse foundries on West Fifty-eighth street. The molding and melting departments occupy more than one-half of the building, covering an area of approximately 135 x 165 feet. The air furnace is in the center of this section, provision having been made for the installation of a second unit. In the other part of the structure, 107 x 165 feet, are the annealing ovens, assorting and packing floor, hard and soft iron tumbling mills, grinders, core and shipping rooms. The core room is entirely enclosed, constituting practically a detached building and the hard and soft iron floors are separated by a brick wall, 6 feet 6 inches high. The annealing ovens were built by Holcroft & Co., Detroit.

The roof construction of the foundry is outlined in the front view of the building, Fig. 11, and that it affords ample daylight to every part of the shop is shown by Figs. 10 and 12. While the building is of mill construction, the large number of columns do not interfere with the floors.

Employes of the Pangborn Corp., Hagerstown, Md., have been presented with life insurance policies varying in amounts from $500 to $1000 according to length of service.

Steel Casting Prices Fixed by the Government

Where to Go and Whom to See in Washington, With the Complete Schedule of Agreed Quotations on Cast Parts, Including Also Iron Rolls and Pinions

PRICE fixing under government supervision has already made quite extensive headway in the foundry industry. In the November, 1917, issue of THE FOUNDRY, pages 511 to 513, were published agreed foundry iron, scrap and coke prices and it was predicted that the foundry product as well as its raw material soon would be government controlled. Late in December, the committee of steel casting manufacturers, appointed at a general meeting of representatives of the trade, announced a comprehensive schedule of prices through the general iron and steel committee of the American Iron and Steel institute. Subsequently, agreed prices were made on sand and chilled rolls and iron pinions. It is the intention to establish uniform, agreed quotations on nonferrous metal, malleable and gray iron castings, although no definite action in this direction has yet been taken.

Fixed Price Booklet

A 44-page booklet, 6 x 8¼ inches, containing all of the official prices, extras and differentials fixed by the government on various iron and steel products, has been issued by the Penton Publishing Co., and is ready for distribution. Subscribers to THE FOUNDRY *will be furnished with copies on application, without cost. All the price data on ore, pig iron, coke, scrap iron and steel, steel castings, iron rolls, rolled iron and steel products, etc., have been grouped and correlated according to the nature of the product and have been indexed alphabetically for quick reference. It also contains the complete story of price-fixing by the government.*

The War Service committee of the American Foundrymen's association has appointed C. E. Hoyt, of Chicago, secretary, and has opened offices in the National Union building, 918 F street, N. W., Washington, D. C. From these headquarters will be directed all of the committee's activities in connection with co-operation with the government in the distribution of contracts for castings. Sub-committees on malleable and gray iron already have been named and the members of the subcommittees on steel and nonferrous castings are being selected and will be announced in the near future. A questionnaire has been prepared, which is being mailed to all of the foundrymen in the United States and from the data thus obtained a survey of the foundry trade of this country will be made. Information is being sought on the melting equipment, capacity, output, fuel consumption, nature of product, number of employes, etc., of all plants and when these data have been compiled they will be available to all of the purchasing agents of the various government buying departments. R. A. Bull, Duquesne Steel Foundry Co., Pittsburgh, chairman of the American Foundrymen's war service committee and a major in the officers' reserve corps, having been called for active duty, has resigned. He has been succeeded by H. D. Miles, vice chairman, Buffalo Foundry & Machine Co., Buffalo. The malleable and gray iron subcommittees already appointed, follow:

Malleable Iron.—Frank J. Lanahan, Fort Pitt Malleable Iron Co., Pittsburgh; H. F. Pope, National Malleable Castings Co., Cleveland; F. L. Sivyer, Northwestern Malleable Iron Co., Milwaukee; John E. Walker, Wilmington Malleable Iron Works, Wilmington, Del., and John C. Haswell, Dayton Malleable Iron Co., Dayton, O., who is a member of the general committee representing the malleable cast iron industry.

Gray Iron.—Henry A. Carpenter, General Fire Extinguisher Co., Providence, R. I.; W. D. Tynes, Hardie-Tynes Mfg. Co., Birmongham, Ala.; F. B. Whitlock, Interstate Foundry Co., Cleveland, and W. P. Whelan, Western Foundry Co., Chicago.

The Washington office of the War Service committee of the American Foundrymen's Association also will serve as a bureau of information for the foundrymen of the country, regardless of their affiliation with this organization, on all subjects relating to casting work for the government. The expense of this undertaking is being defrayed from the funds of the association.

Owing to the tremendous expansion of the war and navy departments, considerable difficulty is being experienced by foundrymen in locating the purchasing agents for various classes of castings. These officers are scattered all over Washington, including the down town and residential districts. To facilitate correspondence and personal interviews, a list of these officers has been compiled giving the address, persons to be consulted and details of purchases made. This list is appended, with the agreed schedules of prices for steel castings, sand and chilled iron rolls, iron pinions, cast iron water pipe, nonferrous metals, iron and steel scrap and the recently announced differentials on low phosphorus pig iron prices and the agreed quotations for special car wheel or cylinder iron.

Government Purchasing Offices in Washington

War Department, Office of Chief of Ordnance

Carriage Division.—Lieut. Col. J. H. Rice, room 139, State, War and Navy building.

Field Artillery Section.—Lieut. Col. L. T. Hillman, 18th and E streets, N. W.; field artillery material, except guns and ammunition.

Seacoast Artillery Section.—Major J. B. Dillard, 18th and E streets, N. W.; seacoast material and railway mounts and equipment, except guns and ammunition.

Motor Equipment Section.—Major L. B. Moody, 1703 New York avenue; all motor equipment for field artillery tractors, ammunition trucks, tanks, etc.

Anti-Aircraft Section.—Major J. B. Rose, 18th and E streets, N.

W.; anti-aircraft mounts and equipment except guns, ammunition and motor equipment.

Gun Division

COLONEL J. E. HOFFER, B STREET AND VIRGINIA AVENUE, N. W.

Artillery Ammunition Section.—Lieut. Col. E. P. O'Hearn; artillery ammunition of all description from 3 to 16-inch in caliber; armor-piercing projectiles, steel shells, shrapnel, etc.

Cannon Section.—Major C. C. Jamison; cannon of all character from 3 to 16-inch; forgings for cannon, breech and firing mechanisms.

Trench Warfare Section.—Captain E. J. W. Ragsdale; hand and rifle grenades, aerial bombs and trench mortars.

Raw Materials.—Major Douglas I. McKay; materials used in the manufacture of ordnance, such as steel, copper, spelter, lead, antimony, etc.

Aircraft Division

PURCHASES FOR SIGNAL CORPS, OLD SOUTHERN RAILWAY BUILDING

Motors and Parts.—Lieut. H. H. Emmons.

Planes:—H. L. Shepler.

Ordnance and Instruments for Signal Corps.—L. S. Horner.

Woods, etc.—Capt. H. P. Moore.

Transportation Divisions

STATE, WAR AND NAVY BUILDING, COL. G. B. DRAKE IN CHARGE

Col. Drake is in charge of motor transportation including automobiles, motor trucks, motorcycles, tractors, trailers, harbor boat service, etc.

Capt. H. A. Hegeman, in charge of transport repair shops, machinery and equipment for repair shops being organized for service abroad.

Major C. M. Curran, in charge of rail transportation, railroad equipment, repair, etc., after installation.

Major J. W. Furlow, in charge of engineering features of motor transportation in connection with testing of motor trucks with the view of standardization.

Navy Department, Bureau of Ordnance

NEW INTERIOR BUILDING, 18TH AND F STREETS, N. W.

Commander T. A. Keraney, requisitions for material for all yards and stations.

Lieut. N. W. Pickering, guns and breech mechanism.

Lieut. L. S. Bye, guns and breech mechanism.

Commander T. V. Ogan, torpedoes.

Lieut. Comdr. R. S. Holmes, armor and projectiles.

Lieut. Comdr. S. C. Rowan, mounts, other than turrets and small arms.

Commander S. P. Fullinwider, mines and mining, and wire rope.

Commander F. H. Clark, armor and projectile plant to be constructed at Charleston, W. Va.

Bureau of Supplies and Accounts

Purchase all miscellaneous supplies and equipment for the navy; State, War and Navy building.

Bureau of Yards and Docks

In charge of contracts for navy construction; Navy annex, New York avenue.

U. S. Shipping Board

EMERGENCY FLEET CORPORATION, 1319 F STREET

A. L. Bell, boilers and machinery other than electrical.

W. R. McCann, electrical apparatus and machinery.

J. P. Bourke, anchor chain, wire rope, miscellaneous equipment and supplies.

G. R. Jasper, raw and semi-finished materials on which the government expects to have prices fixed.

E. A. Rebbeka, inspection of material bought by purchasing department.

T. D. Adams, contracts and specifications.

Agreed Prices for Steel Castings

Column Bases, Bridge Blocks and Shoes

When ordered in quantities as follows, from one pattern at one time:

Division of weight, pounds	1 to 9	10 to 24	25 to 49	50 to 99	100-over
501– 750	7.75c	7.70c	7.50c	7.40c	7.30c
751– 1,000	7.70c	7.65c	7.40c	7.30c	7.20c
1,001– 2,000	7.65c	7.50c	7.30c	7.20c	7.15c
2,001– 3,000	7.50c	7.40c	7.20c	7.15c	7.00c
3,001– 5,000	7.40c	7.30c	7.15c	.....	.....
5,001–10,000	7.30c	7.15c	.....	.....	.....
10,001–20,000	7.50c	7.30c	.....	.....	.....
20,001–50,000	7.70c	.....	.....	.....	.....

Two ($2) dollars each is to be added for test bars in excess of two per heat.

Suitable pattern equipment to be furnished by the customer.

Boiler Castings and Fittings, Light Section

Standard low pressure flange fittings and steam piping, headers, manifolds, crossovers, steam separators, steam traps, ammonia fittings of lighter section than standard thickness or more intricate than the regular run of fittings.

Division of weight, pounds		Division of weight, pounds	
1– 10	41.50c	301– 500	17.30c
11– 25	35.45c	501–1000	15.50c
26– 50	27.00c	1001–2000	14.90c
51–100	22.15c	2001–3000	14.30c
101–200	20.95c	Over 3000	13.65c
201–300	19.70c		

Suitable pattern equipment to be furnished by the customer.

Boiler Castings and Fittings, Heavy Section

Boiler saddles and cross boxes, nozzles, man and hand hole frames and covers, valve bodies and valve parts, flange fittings and steam piping of extra heavy or high pressure thickness, hydraulic fittings, ball and socket joints for dredges and dredge piping.

Division of weight, pounds		Division of weight, pounds	
1– 10	35.80c	301– 500	14.00c
11– 25	29.75c	501–1000	13.40c
26– 50	21.30c	1001–2000	12.80c
51–100	17.65c	2001–3000	12.20c
101–200	16.45c	Over 3000	11.60c
201–300	15.25c		

Suitable pattern equipment to be furnished by the customer.

Flange Schedule

When ordered in quantities from one pattern at one time as follows:

Division of weight, pounds	1 to 49	50 to 100	101-over
1– 10	28.75c	27.30c	25.95c
11– 25	23.90c	22.65c	21.55c
26– 50	17.85c	16.90c	16.05c
51–100	15.45c	14.65c	13.90c
101–200	14.20c	13.45c	12.75c
201–300	13.00c	12.30c	11.65c
301–500	12.75c	12.05c	11.40c
501-over	11.80c	11.15c	10.55c

Suitable pattern equipment to be furnished by the customer.

Engine Castings

Division of weight, pounds	Miscellaneous castings	Gas engine cylinders Cast in one pc	Gas engine cylinders Cast in two pcs.	Chambered pistons and cylinder heads	Flywheel segments and hubs, crank discs, crank webs and counter balances
1– 10	31.55c	35.55c	34.30c	34.30c	31.05c
11– 25	23.30c	27.30c	26.05c	26.05c	22.80c
26– 50	18.65c	22.65c	21.40c	21.40c	18.15c
51– 100	15.00c	19.00c	17.75c	17.75c	14.50c
101– 200	12.65c	16.65c	15.40c	15.40c	12.15c
201– 300	11.70c	15.70c	14.45c	14.45c	11.20c
301– 500	11.05c	15.05c	13.80c	13.80c	10.55c
501–1000	10.30c	14.30c	13.05c	13.05c	9.80c
1001–2500	9.65c	13.65c	12.40c	12.40c	9.15c
2501–5000	9.10c	13.10c	11.85c	11.85c	8.60c
Over 5000	8.90c	12.90c	11.65c	11.65c	8.40c

For carbon over 0.40 per cent add ½c per pound to these prices.

Suitable pattern equipment to be furnished by the customer.

Old Style Anchors

Pounds		Pounds	
101– 250	17.85c	1001–3000	11.80c
251– 500	14.20c	3001-over	10.60c
501–1000	13.00c		

For chemical or physical test, add ½c per pound.
Other tests to be paid for by purchaser.
Suitable pattern equipment to be furnished by the customer.

Propeller Wheels

Pounds		Pounds	
101– 300	35.90c	3001– 4000	14.15c
301– 600	28.65c	4001– 4500	13.85c
601–1000	21.40c	4501– 7000	13.25c
1001–2000	18.95c	7001–10000	12.30c
2001–2500	16.55c	10001–12000	11.70c
2501–3000	15.35c	Over 12000	11.10c

Suitable pattern equipment to be furnished by the customer.

Cement Mill Castings, Machinery Builders' Schedule

Riding rings and tires...	3000 pounds and over	9.20c
Riding rings and tires...	Under 3000 pounds use miscellaneous schedule below.	
Rollers	Under 500 pounds use miscellaneous schedule below.	
Rollers	500 pounds and over	9.20c
Gears and pinions	Use gear schedule.	

Miscellaneous Castings

Pounds.		Pounds	
Under 50	18.90c	501–1000	10.75c
51–100	13.90c	Over 1000	9.90c
101–500	12.00c		

Suitable pattern equipment to be furnished by the customer.

Cement Mill Castings, Consumers' Schedule

Riding rings and tires...	3000 pounds and over	9.20c
Riding rings and tires...	Under 3000 pounds use miscellaneous schedule below.	
Rollers	Under 500 pounds use miscellaneous schedule below.	
Rollers	500 pounds and over	9.20c
Gears and pinions	Use gear schedule.	
Fan castings		16.35c

Miscellaneous Castings

Pounds		Pounds	
Under 50	21.30c	201-600	13.15c
51-200	15.35c	601-over	10.70c

Suitable pattern equipment to be furnished by the customer.

Gear Schedule

Gears, Pinions, Segments, Racks, Worms, Worm Wheels, Sprockets, Sheaves and Pulleys

When ordered in quantities from one pattern at one time as follows:

Division of weight, pounds	1 to 49	50 to 99	100 and ov.
1– 10	30.20c	25.60c	21.05c
11– 25	22.00c	18.65c	15.30c
26– 50	18.00c	15.25c	12.50c
51– 100	13.90c	11.75c	.....
101– 200	11.80c	.....	.....
201– 300	10.75c	.....	.....
301– 500	9.75c	.....	.....
501–1000	9.20c	.....	.....
1001–2500	8.80c	.....	.....
2501–5000	8.35c	.....	.....
Over 5000	8.05c	.....	.....

For carbon over 0.40 per cent, add ½ cent per pound. For physical tests, add ½ cents per pound.
For other alloys, add same as on rolls.
Above prices do not cover machine-molded gears.
Suitable pattern equipment to be furnished by the customer.

Crane Castings

Pounds		Pounds	
1– 10	31.85c	301– 500	10.65c
11– 25	23.40c	501–1000	10.10c
26– 50	19.20c	1001–2500	9.70c
51–100	14.90c	2501–5000	9.20c
101–200	12.80c	Over 5000	8.95c
201–300	11.80c		

For end carriages and trucks, add 0.65 cent to above prices.
For trolley frames, motor supports, gear covers, bumper hoods, stripper rams and sleeves, charging bar supports, center stem castings, hollow shafts and stems, upper and lower guide brackets and ram frames, peels and peel heads and other intricate castings, add 1.50c to above prices.

Long Hollow Rack Castings

13.45c per pound
Suitable pattern equipment to be furnished by the customer.

Mine and Industrial Car Castings

When purchased in quantities as follows from one pattern at one time:

Division of weight, pounds	Under 100 castings	100-499 castings	500 castings and over
1-10	21.70c	19.50c	18.60c
11-25	15.35c	14.75c	14.00c
26-50	10.55c	10.15c	9.75c
51-100	10.00c	9.70c	9.55c
Over 100 pounds	9.55c	9.30c	9.10c
Link and pin draw heads	9.10c	8.70c	8.20c

Add ½ cent per pound to above prices for cradles, column guides, rockers and pedestals.
Suitable pattern equipment to be furnished by the customer.

Mine and Industrial Car Wheels

On contracts covering not less than 500 wheels per month and on single orders for 500 wheels or more, use the following prices:

Division of weight, pounds	Single flange or web plate wheels with plain hub	Spoke wheels	Double flange, double tread, straight or flat tread or self-oiler wheels
10- 25	10.60c	10.85c	11.35c
26- 40	9.45c	9.70c	10.20c
41- 75	8.50c	8.75c	9.25c
76-100	8.05c	8.30c	8.80c
Over 100	7.70c	7.95c	8.45c

Suitable pattern equipment to be furnished by the customer.

Domestic Car Castings

When purchased in quantities as follows, from one pattern at one time:

Name of castings or division of weight	Under 50 castings	50-249 castings	250-499 castings	500 castings and over
Bolster center fillers	11.25c	9.95c	9.05c	8.60c
Center plates	10.25c	9.25c	8.25c	7.95c
Draft lugs	10.25c	8.95c	8.20c	7.80c
Journal box wedges	13.25c	11.60c	10.60c	10.05c
Push pole pockets	10.25c	8.95c	8.20c	7.80c
Roping and jacking cast's.	13.25c	11.60c	10.60c	10.05c
Side bearings	13.25c	11.60c	10.60c	10.05c
Striking castings	10.25c	9.25c	8.25c	7.95c
Other castings, 1- 5 lb.	22.75c	20.05c	18.15c	17.40c
Other castings, 6-10 lb.	18.75c	16.55c	15.05c	14.25c
Other castings, 11-25 lb.	15.40c	13.55c	12.25c	11.75c
Other castings, 26-50 lb.	12.75c	11.25c	10.25c	9.75c
Other castgs over 50 lb.	10.75c	9.40c	8.60c	8.15c

Patterns extra, unless 500 or more castings are ordered from one pattern at one time.

Foreign Car Castings

	Cents per pound
Buffer castings	10.95
Buffer housings	11.60
Other castings, 1-5 lb.	20.60
Other castings, 6-10 lb.	18.95
Other castings, 11-15 lb.	17.30
Other castings, 16-25 lb.	14.95
Other castings, 26-50 lb.	13.30
Other castings, over 50 lb.	11.60

Note—If center plates and side bearings of American design are required, use domestic car prices for these items.
Patterns extra, unless 500 or more castings are ordered from one pattern at one time.

Miscellaneous Railroad and Locomotive Castings

	Cents per pound
Driving wheel centers	7.70
Engine frames	8.20
Miscellaneous castings, under 5 lb.	19.70
Miscellaneous castings, 5-10 lb.	17.70
Miscellaneous castings, 11-25 lb.	14.20
Miscellaneous castings, 26-50 lb.	12.20
Miscellaneous castings, 51-100 lb.	10.70
Miscellaneous castings, 101-250 lb.	10.20
Miscellaneous castings, 251-500 lb.	9.70

	Cents per pound
Miscellaneous castings, 501-1000 lb.	9.20
Miscellaneous castings, over 1000 lb.	8.70

Note—for engine frames weighing less than 2000 lbs. each add 3.00c per lb.

Suitable pattern equipment, etc., to be furnished by the customer.

Rail or Step Joint Castings

	Cents per pound
Rail or joint step castings, in any quantity	10.50

Suitable pattern equipment to be furnished by the customer.

Refractory and Brick Yard Castings

	Cents per pound
Scrapers and toggle plates	13.05
Pan rims	11.80
Roller tires	10.75
Bottom plates	10.75
Swinging and stationary dies	11.15
Outside circle plates	11.80
Inside circle plates	11.80
Other castings, under 10 lb.	29.85
Other castings, 11-25 lb.	25.55
Other castings, 26-50 lb.	23.00
Other castings, 51-100 lb.	17.55
Other castings, 101-200 lb.	15.80
Other castings, 201-500 lb.	13.00
Other castings, 501-1000 lb.	12.20
Other castings, 1001-2500 lb.	11 70
Other castings, over 2500 lb.	10.90

Suitable pattern equipment to be furnished by the customer.

Jaw and Gyratory Crusher Castings

Pounds		Pounds	
Under 25	31.45c	401-500	11.40c
26-50	21.55c	501-750	10.60c
51-75	18.65c	751-1000	10.20c
76-100	15.70c	1001-2000	9.30c
101-150	15.00c	2001-3000	9.00c
151-200	14.25c	3001-5000	8.65c
201-300	12.95c	5001-10000	7.85c
301-400	12.15c	Over 10000	7.55c

For jaw crusher frames made in one piece and gyratory crusher housings, add 20 per cent to foregoing schedule.

For gears, bushings and sleeve castings, use gear schedule.

Suitable pattern equipment to be furnished by the customer.

Road and Mining Machinery Castings

Pounds		Pounds	
Under 25	34.50c	401-500	12.45c
26-50	23.60c	501-750	11.60c
51-75	20.40c	751-1000	11.05c
76-100	17.25c	1001-2000	10.45c
101-150	16.05c	2001-3000	9.75c
151-200	15.60c	3001-5000	9.25c
201-300	14.15c	5001-10000	8.55c
301-400	13.25c	Over 10000	8.15c

For gears, bushings and sleeve castings, use gear schedule.

Suitable pattern equipment to be furnished by the customer.

Alloy Steel Castings

Differentials to be added to the prices for carbon steel castings.

	Cents per pound
Nickel Steel:	
For 2.50 to 3.5 per cent nickel	add 3.50
Vanadium Steel:	
For approximately 0.18 per cent vanadium	add 2.50
Chrome Steel:	
For approximately 1 per cent chromium	add 1.50
Chrome Nickel Steel:	
For approximately 1 per cent chromium and 2 per cent nickel	add 4.00
Chrome Vanadium Steel:	
For approximately 1 per cent chromium and 0.18 per cent vanadium	add 4.00
Titanium Steel:	
For any per cent of titanium specified	add 1.50

Rolling Mill Steel Castings

The following prices for rolling mill castings are subject to discounts shown below:

0.25c per lb., under 750 tons per year
0.45c per lb., 750-2000 tons per year
0.65c per lb., 2000-7500 tons per year
0.75c per lb., over 7500 tons per year

except that annealing boxes and annealing bottoms, charging boxes and charging box heads and ends are subject to a discount of only 0.25c per pound when total requirements amount to less than 7500 tons, and only 0.35c per pound when total requirements amount to more than 7500 tons.

Steel Castings for Rolling Mills and Steel Works

ROLLS, UNFINISHED

Pounds, inclusive.	Cents per pound
101 to 500	11.80
Over 500 to 1000	10.70
Over 1000 to 2500	9.70
Over 2500 to 5000	8.85
Over 5000 to 10000	7.95
Over 10000 to 50000	7.70
Over 50000 to 100000	8.95

PINIONS, UNFINISHED

Pounds, inclusive.	Cents per pound
101 to 500	13.55
Over 500 to 1000	12.05
Over 1000 to 2500	10.80
Over 2500 to 5000	9.55
Over 5000 to 10000	8.60
Over 10000 to 50000	8.05
Over 50,000 to 100000	8.95

The above prices of rolls and pinions are for 0.50 per cent carbon or under. For carbon over 0.50 and under 0.70 add ¼ cent to above prices; for carbon 0.70 and under 1.50 add ½ cent to above prices; for carbon 1.50 and over add ¾ cent to above prices. Extra for 2½ to 3½ per cent nickel, 3½ cents per pound. Extra for approximately 0.18 per cent vanadium, 2½ cents per pound. No extra for annealing rolls and pinions.

Annealing Boxes and Pots (Unfinished)

Boxes 1 inch thick and over, per pound	8.35c
Boxes less than 1 inch thick, per pound	10.40c

When steam test is required, add ¼ cent per pound.

Annealing Bottoms

72 inches inside length and under, per pound	7.60c
Over 72 inches inside length, per pound	6.80c

Charging Boxes

Charging boxes, per pound	7.45c

Charging Box Heads and Ends

In lots of 50 to 100 from one pattern:	
With rivet holes cored, per pound	9.65c
With rivet holes not cored, per pound	9.10c
In lots over 100 from one pattern:	
With rivet holes cored, per pound	9.25c
With rivet holes not cored, per pound	8.60c

Rolling Mill and Steel Works Miscellaneous Castings

NOT OTHERWISE SPECIFIED ON THIS LIST

Pounds, inclusive.	Cents per pound
1 to 25	20.00
Over 25 to 50	15.35
Over 50 to 100	11.65
Over 100 to 250	10.70
Over 250 to 500	10.00
Over 500 to 1000	8.70
Over 1000 to 2500	8.30
Over 2500 to 5000	8.10
Over 5000	7.70

Add 20 per cent to above prices for hollow and disc table rollers and cylinders.

Add 1 cent per pound for all castings with water circulating pipes. For carbon over 0.40 per cent add ¼ cent per pound.

If alloys are required, extra to be charged same as on rolls.

Coupling Boxes, Spindles, Roll Housings, Pinion Housings and Anvil Blocks

Pounds, inclusive.	Cents per pound
1 to 25	20.05
Over 25 to 50	15.40
Over 50 to 100	11.70
Over 100 to 250	9.40
Over 250 to 500	8.60
Over 500 to 1000	7.75
Over 1000 to 2500	7.70
Over 2500 to 5000	7.55
Over 5000 to 15000	7.50
Over 15000 to 50000	7.35

Over 50000 to 100000	7.65
Over 100000	8.60

Gears, Gear Blanks, Gear Segments, Racks, Worms, Worm Wheels, Sprockets, Sheaves and Pulleys

Pounds, inclusive.	Cents per pound
1 to 10	30.45
Over 10 to 25	22.25
Over 25 to 50	18.25
Over 50 to 100	14.15
Over 100 to 200	12.05
Over 200 to 300	11.00
Over 300 to 500	10.00
Over 500 to 1000	9.45
Over 1000 to 2500	9.05
Over 2500 to 5000	8.60
Over 5000	8.30

Add ¼ cent per pound for carbon over 0.40 per cent or when chemical or physical tests are required. Foregoing prices are for gears made from patterns furnished by purchaser. Additional charge to be made for machine molded gears. Railway motor gears not included in foregoing schedule.

If alloys are required, extra to be charged same as on rolls.

Steel Castings for Blast Furnaces

Bells, Hoppers, Hopper Extensions, Lip Rings, Tuyere Jacketss, Hot Metal or Slag Pots and Rings—Caps and S Caps

BELLS, HOPPERS, HOPPER EXTENSIONS, LIP RINGS, TUYERE JACKETS, HOT METAL OR SLAG POTS AND RINGS

Valve Bodies, Tuyere Stocks, Pipes, Nozzles and Saddles

50 to 500 pounds inclusive, per pound	12.10c
Over 500 to 1000 pounds inclusive, per pound	10.25c
Over 1000 pounds, per pound	9.35c

Hearth Jackets or Bosh Plates

Under 5000 pounds, per pound	7.70c
Over 5000 pounds, per pound	7.65c

Miscellaneous Blast Furnace Castings Not Specified Otherwise on this List

Pounds, inclusive.	Cents per pound
1 to 25	20.00
Over 25 to 50	15.35
Over 50 to 100	11.65
Over 100 to 250	10.70
Over 250 to 500	10.00
Over 500 to 1000	8.70
Over 1000 to 2500	8.30
Over 2500 to 5000	8.10
Over 5000	7.70

Add 1 cent per pound for all castings with water circulating pipes. For carbon over 0.40 per cent add ¼ cent per pound.

If alloys are required, extra to be charged same as on rolls.

Freight Allowance

The foregoing schedules cover the castings named therein, in the rough, f. o. b. maker's works, with published freight rate allowed to freight station of purchaser to all points in the United States included within a line drawn from Boston, Mass., through Schenectady, Rochester, and Niagara Falls, N. Y., Detroit, Mich., Duluth, Minn., St. Louis, Mo., Cincinnati, Ohio, Washington, D. C., Cape May, N. J., and all Atlantic ocean terminal points between Cape May and Boston. Where deliveries are made outside of boundary line, freight is allowed only to boundary line.

Bolsters, Body or Truck

FREIGHT CARS AND LOCOMOTIVE TENDERS F. O. B. BUILDERS' WORKS OR NEAREST POINT ON RAILROAD IN BASE TERRITORY

Freight Cars	Bolsters—Body or Truck 1 to 10	11 to 100	101 to 199	200 and over
30-ton	$116.00 per car	$113.00 per car	$97.00 per car	$87.50 per car
40-ton	126.00	123.00	109.00	99.50
50-ton	136.00	133.00	119.00	108.50
57½-ton	146.00	143.00	127.00	118.50
62½-ton	156.00	153.00	137.00	130.00
70-ton	176.00	175.00	174.00	165.50

Tenders, all capacities, $9.50 per 100 pounds.

In case of any capacity car other than those shown, price for the next succeeding higher capacity will apply.

Note 1.—Base territory is east of the Mississippi river, north of the Ohio river and west of the Hudson river, including Bettendorf, Iowa, St. Louis, Mo., and Huntington, W. Va.

Note 2.—The foregoing prices on body and truck bolsters apply to bolsters of usual dimensions *without* center plates, or *with* integral center plates, ordinary friction side bearings, column guides and dead lever lugs.

Note 3.—Body bolsters of unusual designs exceeding the weight of standard designs will take an extra charge to cover the excess weight.

Note 4.—**Separable center plates,** if furnished free of charge f. o. b. manufacturer's foundry, separable center plates will be riveted on bolsters at an additional charge of $2.00 per car.

Note 5.—Side bearing wearing plates or patented side bearings, if furnished free of charge f. o. b. manufacturer's foundry, side bearing wearing plates or patented side bearings will be riveted on bolsters at an additional charge of $2.00 per car per item.

Note 6.—The foregoing prices do not include drilling or machine work.

Note 7.—For freight cars, where new patterns are required for bolsters for orders of less than 100 castings from any one pattern, an extra charge of $200.00 for each of the patterns shall be made.

Note 8.—For locomotive tenders, where new patterns are required for bolsters for orders of 10 locomotives or less from any one pattern, an extra charge of $200.00 for each of the patterns shall be made.

Truck Side Frames, Freight Cars and Locomotive Tenders

F. O. B. BUILDERS' WORKS OR NEAREST POINT ON RAILROAD IN BASE TERRITORY

Side Frames—Andrews or Pedestal

Freight cars	From 1 to 10	11 to 100	101 to 399
30-ton	$150.00 per car	$147.00 per car	$132.00 per car
40-ton	160.00	157.00	144.00
50-ton	170.00	167.00	160.00
57½-ton	180.00	179.00	172.00
62½-ton	198.00	195.00	188.00
70-ton	218.00	217.00	208.00

	Andrews	Pedestal
400 and over, 30-ton	$118.50 per car	$124.50 per car
40-ton	129.50	135.50
50-ton	139.50	151.50
57½-ton	154.50	166.50
62½-ton	170.00	181.00
70-ton	175.50	201.50

Tender Frames

	Andrews or Pedestal regular design, per frame
Less than 50-ton capacity	$51.00
50-ton and less than 70-ton capacity	66.00
70-ton capacity	71.00

In case of any capacity car other than those shown, prices for the next succeeding higher capacity will apply.

Note 1.—Base territory is east of the Mississippi river, north of the Ohio river and west of the Hudson river, including Bettendorf, Iowa, St. Louis, Mo., and Huntington, W. Va.

Note 2.—The foregoing prices on frames cover castings only and of usual dimensions and do not include journal boxes, bolts, spring planks, tie bars, rivets, wearing plates, loose brake hanger pins, fastenings, etc.

Note 3.—The foregoing prices do not include drilling or machine work nor do they cover pedestal frames employing a binder for connecting jaws underneath the journal boxes.

Note 4.—For freight cars, when new patterns are required for frames, for orders of less than 100 castings from any one pattern, an extra charge of $200.00 for each of the patterns shall be made.

Note 5.—For locomotive tenders, when new patterns are required for frames, for orders of 10 locomotives or less from any one pattern, an extra charge of $200.00 for each of the patterns shall be made.

List Prices Delivered to Car and Locomotive Builders in Base Territory, Carload and Less Carload Shipments, for Estimating Purposes

Capacity in tons	Andrews or Pedestal side frames	Truck or body bolsters
30-ton	$155.00 per car	$120.00 per car
40-ton	165.00	130.00
50-ton	175.00	140.00
55-57½-ton	185.00	150.00
60-62½-ton	205.00	160.00
65-70-ton	225.00	180.00
Locomotive tenders, all capacities	300.00 per tender	300.00 per tender

Note 1.—Base territory is east of the Mississippi river, north of the Ohio river and west of the Hudson river, including Bettendorf, Iowa, St. Louis, Mo., and Huntington, W. Va.

Note 2.—For locomotive tenders, where new patterns are required for either frames or bolsters, for orders of 10 locomotives or less, an extra charge of $200.00 each for the patterns shall be made. Prices do not include drilling or machine work, nor do they cover pedestal frames employing a binder for connecting the jaws underneath the journal boxes.

Note 3.—For freight cars, where new patterns are required for either frames or bolsters, for orders of less than 100 castings from any one pattern, an additional charge of $200.00 each shall be made. Prices do not include drilling or machine work.

Note 4.—The foregoing prices on side frames cover castings only and do not include journal box bolts, tie bars, rivets, loose brake hanger pins, fastenings, etc.

Note 5.—The foregoing prices on body or truck bolsters apply to bolsters *without* center plates, or *with* integral center plates, ordinary friction side bearings, column guides and dead lever lugs.

Note 6.—**Separable center plate,** if furnished free of charge f. o. b. manufacturer's foundry, separable center plates will be riveted to the bolster at an additional charge of $2.00 per car.

Note 7.—**Side bearing wearing plates or patented side bearings,** if furnished free of charge f. o. b. manufacturer's foundry, side bearing wearing plates or patented side bearings will be riveted to the bolsters at an additional charge of $2.00 per car per item.

Prices of M. C. B. A. Couplers

M. C. B. A. couplers with heads measuring not more than 9¼ inches from the pulling face of the knuckle, when closed, to the horn, shanks not more than 21¼ inches long and fitted with 9 inch face knuckles.

Freight Equipment Couplers

Old M. C. B. A. standard type top operating couplers without uncoupling chains:

5 x 5 inch shanks with 6½ inch butt ends, per pair.....$38.25
5 x 7 inch shanks with 6½ inch butt ends, per pair..... 39.05

New M. C. B. A. standard top operating type "D" couplers with regular dimension of head, shanks not more than 21¼ inches long, fitted with 9-inch face knuckles and without uncoupling chains:

6 x 8-inch shanks with 6½-inch butt ends, per pair.....$51.00
5 x 7-inch shanks with 6½-inch butt ends, per pair..... 50.20

If top operating couplers are required fitted with uncoupling chains, there will be an additional charge of $1.00 per pair to the above prices.

If couplers are required with butt ends more than 6½ inches, there will be an additional charge of $1.30 per pair to the foregoing prices.

If couplers are required with shanks more than 21¼ inches long, there will be an additional charge to the foregoing prices of 60 cents per pair for each additional inch or fraction thereof.

If couplers are required with wider face knuckles than 9 inches, there will be an additional charge to the foregoing prices of 40 cents per pair for each additional inch or fraction thereof.

If couplers are required with special reinforcement around key slot heavier than shown on M. C. B. A., Standard Sheet No. 23, there will be an additional charge of $1.00 per pair to the foregoing prices.

If couplers are required fitted for side or bottom operation, there will be an additional charge of $2.00 per pair to the foregoing prices.

Passenger Equipment Couplers

Passenger equipment couplers, old M. C. B. A. standard type, measuring not more than 4 feet from the pulling face of the knuckle, when closed, to the end of the shank, fitted with 9-inch face knuckle, $28.50 each.

If passenger equipment couplers are required measuring more than 4 feet from the pulling face of the knuckle, when closed, to the end of the shank, there will be an additional charge to the above price of 40 cents each for each additional inch or fraction thereof.

If passenger equipment couplers are required with wider face knuckles than 9 inches, there will be an additional charge to the above price of 20 cents each for each additional inch or fraction thereof.

If passenger equipment couplers are required having butt ends with anti-spread lugs for quadruple shear feature, there will be an additional charge of $3.00 per coupler.

Locomotive Tender Couplers

Short shank swing head locomotive couplers and special tender couplers, old M. C. B. A. standard type, fitted with 11-inch face knuckles, and without uncoupling chains, $23.80 each.

New M. C. B. A. standard type "D" short shank swing head locomotive couplers and special tender couplers, fitted with 11-inch face knuckles and without uncoupling chains, $31.30 each.

Add for chains, 50 cents each.

If locomotive couplers are required with wider face knuckles than 11 inches, there will be an additional charge to the foregoing prices of 20 cents each for each additional inch or fraction thereof.

If locomotive tender couplers are required with shanks more than 21¼ inches long, there will be an additional charge to the foregoing prices of 40 cents each for each additional inch or fraction thereof.

If in order to secure the clearances now required by the Interstate Commerce Commission, couplers of old M. C. B. A. standard type are required with heads measuring more than 9¼ inches from the pulling face of the knuckle, when closed, to the horn, the following additional charges, to the foregoing prices, will be made:

	Per pair
Over 9¼ inches but not more than 11½ inches.....	$3.00
11½ inches, but not more than 14 inches.....	6.50
14 inches, but not more than 15¼ inches.....	7.50

Delivery f. o. b. cars works of manufacturer with freight allowed at the carload rate to point on railroad line nearest manufacturer's coupler foundry, or to any car or locomotive building plant located north of the Ohio, east of the Mississippi and west of the Hudson rivers, including Bettendorf, Iowa, St. Louis and St. Charles, Mo., Huntington, W. Va., and Curtis Bay, Md.

If the freight rate is advanced during the period in which these prices are effective, the amount of such advance will be added to the prices as given.

All the foregoing prices apply only to steel castings of the general type, design or specification mentioned.

Prices for special designs or specifications will be subject to negotiation.

Iron and Steel Scrap Prices

Base Prices Approved by President Wilson, Nov. 5, 1917.

Prices f. o. b. consuming point.

	Per ton
No. 1 heavy melting scrap.....	$30.00
Cast iron borings and machine shop turnings.....	20.00
No. 1 railroad wrought	35.00

Prices of Iron and Steel Scrap Recommended by the Committee on Steel and Steel Products of the American Iron and Steel Institute, Dec. 22, 1917:

No. 1 Heavy Melting Scrap

The maximum price of $30 per gross ton, f. o. b. consumer's works, shall apply to all grades of iron or steel scrap to be melted, which normally sold at or under the price of No. 1 heavy melting steel scrap, including malleable cast scrap of all kinds, and cast iron scrap of all kinds, including iron car wheels.

A special charge of not to exceed $3 per gross ton may be paid for cutting heavy melting scrap to sizes 18 inches and under in length.

Parties operating acid open-hearth furnaces, or crucibles, converters or electric furnaces making tool steel or steel castings, may pay a maximum of $10 per gross ton over the base price of heavy melting scrap, for scrap guaranteed not to exceed 0.04 per cent in phosphorus and 0.04 per cent in sulphur. Such parties may also pay a differential of not to exceed $5 over the base price of heavy melting scrap for low phosphorus material not guaranteed as to analysis.

Steel rails 56 pounds per yard and heavier, 5 feet and over in length, suitable for rerolling purposes, may be purchased at a differential of not more than $5 over the base price of heavy melting steel scrap provided the purchaser currently operates mills for rerolling such rails.

Parties operating mills rerolling old locomotive tires, axles, arch bars, transoms, shafting or similar rerolling material, shall not pay more than $47.50 per gross ton, the base price of 4 x 4-inch rerolling billets, for such material delivered at their works.

No. 1 Railroad Wrought Scrap

The maximum price of $35 per gross ton, f. o. b. consumer's works, applies to all scrap used by iron rolling mills which normally sold at or under the price of No. 1 railroad wrought scrap, and includes yard scrap, track scrap, short wrought, busheling, wrought iron or soft steel pipe or similar material normally used by bar iron manufacturers.

The term "busheling" scrap used in this ruling means scrap suitable for busheling furnaces.

Cast Iron Borings and Machine Shop Turnings

The maximum price of $20 per gross ton, f. o. b. consumer's

works, applies only to turnings and borings used for remanufacture into iron or steel products.

Parties operating chemical plants, or plants for purposes other than the remanufacture into iron and steel products may pay a differential of not to exceed $5 above the base price.

Parties employing recognized scrap dealers or brokers to purchase scrap for them may pay such dealer or broker a commission for such service, not to exceed 3½ per cent of the actual delivered price of the materials so purchased.

Reasonable commission in accordance with past custom may be paid dealers by producers of scrap for selling their scrap, provided scrap so sold is consigned direct to consumer. If consigned to dealer's yard, payment of commission is not permitted.

Nonferrous Metals

Government Prices for Nonferrous Metals

Although the government, in one form or another, has extended its regulations to a number of the nonferrous metals, copper is tne only one on which a price has been fixed absolutely. The agreement of the producers with the war industries board was announced Sept. 21 to 23½ cents per pound, New York, for all grades. The agreement was not at once clear and there were numerous violations of the spirit of the arrangement, but through supplementary announcements and rules the whole trade finally was brought to this level. Copper scrap was announced Nov. 1 to have a maximum of 23½ cents, refinery. On account of much trouble in caring for small consumers it was announced Nov. 20 that less than carload lots could be sold by certain dealers at 5 per cent commission above 23½ cents, or net 24.67½ cents, New York. For October requirements the government announced that it would buy lead at the average market price for the month, with an 8-cent per pound, St. Louis, maximum, and later announced the same policy to Jan. 1. Regulations of sales of tin were announced Nov. 22 but nothing was said about prices. Speculation in tin has been stopped in England by government order and it is believed American consumers will be obliged to get their metal from the far east. The trade still remains uncertain, however, as to the interpretation of the London action. Differentials over prime western brand have been recommended for several grades of spelter. The price of silver probably will be fixed soon. The government has been buying its aluminum from the Aluminum Co. of America at 27 cents per pound, maker's plant, under an old contract.

Cast Iron Water Pipe

Standard cast iron bell and spigot pipe, 6 inches and larger, class B or heavier, is base.

Per net ton of 2000 pounds without penalty, $49.00 f. o. b. Birmingham, Ala.

Per net ton of 2000 pounds without penalty, $55.35 f. o. b. New York City.

Per net ton of 2000 pounds without penalty, $54.35 f. o. b. Chicago.

DIFFERENTIALS

3-inch	$10.00 over base
4-inch	3.00 over base
Class A or gas pipe	1.00 additional

Agreed Prices on Iron Rolls and Pinions

Prices for Condensed Grain Sand and Chilled Iron Rolls.

The following prices are subject to the usual customs of the trade, as regards terms, guarantees, adjustments, replacements, etc. The delivery point is f. o. b. maker's works, but the prices include an allowance for actual freight, in accordance with published freight rates, to the freight station of purchaser, provided same does not exceed 20 cents per 100 pounds. All freight in excess of 20 cents per 100 pounds to be paid by purchaser. The freight allowance does not include any additional charges at destination for switching service, spotting cars, drayage, cartage, transfer, ferry car service or any other expense over and above that covered by the published freight rate applying to the regular delivery station.

Plain Chilled Rolls

	Cents per pound.
Under 8 in. diameter	10.00
8 in. diameter and under 10 in.	8.75
10 in. diameter and under 13 in.	7.95
13 in. diameter and under 21 in.	7.15
21 in. diameter and under 24 in.	6.15
24 in. diameter and under 33 in., under 91 in. long	5.70
24 in. diameter and under 33 in., 91 in. long and over	6.15
33 in. diameter and under 35 in.	6.15
35 in. diameter and under 39 in.	7.20
39 in. diameter and under 43 in.	8.30
43 in. diameter and under 45 in.	10.25

Rail rolls, 20 inches diameter and over, with open chilled finishing pass on one or both ends, 7.15 cents per pound.

Rail rolls, under 20 inches diameter, with open chilled pass on one or both ends, 7.45 cents per pound.

Plain rolls, part chilled, same price as chilled rolls of like diameter.

Plain chilled rolls requiring over 1½ inches chill, ¼ cent additional, and at purchaser's risk of breakage, regardless of excessive depth of chill.

Sand rolls, with but one or two plain chilled passes, not less than plain chilled rolls of like diameter.

All other rolls having enclosed chilled passes or grooves, not less than 1.7 cents per pound higher than plain chilled rolls of same diameter; chills for making same to be charged for at not over 10 per cent above cost, and when paid for may be delivered to customers on demand.

Gap rolls for shovel mills, ½ cent per pound additional.

Sand Rolls

	Cents per pound.
Under 10 in. diameter	7.95
10 in. diameter and under 13 in.	7.15
13 in. diameter and under 21 in.	5.90
21 in. diameter and under 34 in.	5.50
34 in. diameter and over	5.90

Iron Pinions

	Cents per pound.
Under 10 in. diameter	8.35
10 in. diameter and under 13 in.	7.55
13 in. diameter and under 21 in.	6.35
21 in. diameter and over	5.90

Boxing or crating—2 per cent of face of bill additional.

The foregoing prices for rolls are subject to a discount of ¼ cent per pound where the purchaser sells and ships to the maker the broken and worn out scrap rolls and pinions produced in operation of its mills, not to exceed 70 per cent in weight of new rolls received, at not over $30 per ton of 2240 pounds in trade account, f. o. b. seller's mill. Any excess freight over $2.50 per ton, necessary to transport such scrap rolls and pinions to works of maker to be paid by the seller of the scrap rolls and pinions.

Special Car Wheel or Cylinder Iron

The price for Virginia or other special car wheel or cylinder irons containing over 1.00 per cent manganese may be made by adding to the base price of $33.00, the following differentials for manganese:

Manganese, per cent.	Add per ton.
1.00 to 1.50	$ .50
1.50 to 2.00	1.50
2.00 to 2.50	2.50
2.50 to 3.00	3.50
3.00 to 3.50	4.50
3.50 to 4.00	5.50
4.00 to 4.50	6.50
4.50 to 5.00	7.50
5.00 to 5.50	8.50
5.50 to 6.00	9.50

Low Phosphorus Pig Iron Differentials

For iron with phosphorus over 0.04 per cent, use following scale:

	Add to base price, per ton.	
Phosphorus, maximum per cent.	For copper-free iron	For copper bearing iron
0.040	$20.00	$17.00
0.045	17.50	15.00
0.050	15.00	13.00
0.055	12.50	11.00
0.060	10.00	9.00
0.065	6.50	6.50
0.070	5.50	5.50
0.075	5.00	5.00
0.075-0.09	Use bessemer price	Use bessemer price

Molding Locomotive Cylinder Bushings in Dry Sand on a Jar-Ramming Machine

By Job Goostray

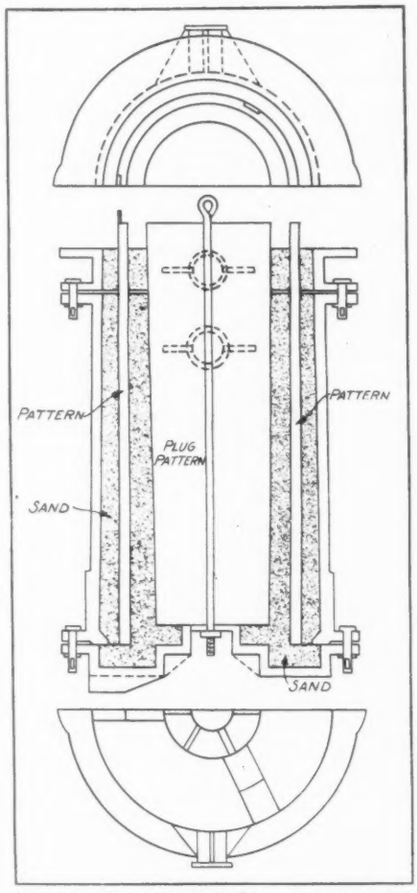
Locomotive cylinder bushings, molded on jar-ramming machines require six sizes of flasks having inside diameters, as follows: 27, 30, 33, 36, 42 and 48 inches. The castings range in sizes from 17⅝ to 39⅝ inches inside diameter, 1 to 1½ inches in thickness, and 36 to 48 inches in length. Flasks, 44 inches long are generally employed. If the castings are less than 44 inches long the core is cut down to the required length. Templets are provided in lengths from 36 to 46 inches, and 6 inches wide, being stamped with the length. When the castings require a 48-inch flask a 4-inch ring is placed on top of a 44-inch flask, thus making the mold 48 inches long.

The accompanying sketch shows a pattern 50 inches long, 29⅝ inches inside diameter, 32 inches outside diameter and with the usual draft allowance. This pattern has a 1¼-inch iron ring, well-secured, on the top for rapping and three wide straps are inserted in the pattern with eyelets for drawing it. A plug pattern is used making a hollow core with a wall of sand 6 inches thick.

A pan drag is used with three projections, 3 inches below the bottom of the pan for bearing, thus obviating the use of blocks. A recess is cast in the pan, 2 inches deep and 5 inches wide, which is rammed very hard before putting on the pattern. A plate could be used and blackened over the same as the mold, but as the iron of which these castings are made is liable to chill it is better to use the pan. The pattern is rubbed with waste dipped in kerosene which facilitates drawing the pattern out of the sand.

A cheek is put on the pan and a plug pattern is placed in the ring of the pan. This ring extends 3 inches above the joint of the pan, strengthening the bottom of the core. A gyratory sand riddle, suspended from a swinging arm and brought over the center of the flask, riddling the sand directly into the flask would save one handling of the sand and the sand would be more evenly distributed in the flask than by putting the sand in with a grab bucket. A sheet iron, funnel-shaped body, 15 inches high, is placed on the top of the flask. This is filled with sand to supply the sand that settles down during the jar-ramming operation. A mold of this size requires about 100 to 125 jolts for a duration of about 1½ to 2 minutes.

The cheek body can be made in one or two pieces and bolted together. A belt is cast on the bottom of the cheek, 6 inches deep. This is where the flask is pounded or sledged to free the casting. About 1 inch of taper in the length of the cheek would help in shaking-out the casting. Two 1¼-inch cotter pins are used. These also secure the flask much better than clamps, as the latter are continually falling off during the jolting of the mold. Covering cores are used on these molds, 6 sections, 6 inches wide, 1½ inches thick, with 12



PLAN AND SECTIONAL VIEWS OF FLASK, PATTERN AND MOLD FOR LOCOMOTIVE CYLINDER BUSHINGS

drop gates and a green sand runner. These molds require clean, hot iron. Filling the molds quickly prevents gas holes or segregations which in a great measure are caused by dull iron or slowly filling the molds.

Associated Foundry Foremen of New York Elect Officers

At the annual meeting of the Associated Foundry Foremen of New York and vicinity, held Jan. 12, George N. Moore of the Robeson Process Co., New York, delivered an address on the "Manufacture and the Use of Glutrin". Officers for the ensuing year also were elected, as follows:

President, Walter H. Hofmann, foundry superintendent, Rickey, Brown & Donald Co., Maspeth, N. Y.; vice president, Robert Walker, foundry superintendent, Abendroth Bros., Port Chester, N. Y.; secretary and treasurer, Walter F. Kaine, president, T. P. Kelly & Co., Inc., New York.

Directors: Charles Ashurst, superintendent, Fuchs & Lang Mfg. Co., Rutherford, N. J.; James Bolland, superintendent, E. W. Bliss Co., Brooklyn, N. Y.; A. W. Braun, president, Edgewater Foundry Co., Edgewater, N. J.; John J. Jung, treasurer, Charles A. Leffert & Co. Iron Foundry, Brooklyn, N. Y.; Fred R. Powell, president, West Bergen & Houston Co., Brooklyn, N. Y.; Wm. S. Sutherland, superintendent, Lord & Burnham Co., Irvington, N. Y.; D. C. Wilson, superintendent, Aetna Foundry Co., Philadelphia. The foregoing, together with the officers, constitute the board of directors.

Building Continuous Kilns

A handsomely illustrated 40-page booklet, published by the American Clay Machinery Co., Bucyrus, O., shows the progressive steps entailed in the building of a large continuous kiln for the Lincoln Paving & Block Co., Corning, O. The booklet is entitled "Camera Construction" and the different views show the progressive steps in the building of this kiln, containing 36 chambers, and which has a total length of 451 feet. Each chamber has a capacity of 1000 paving blocks. This large kiln was started Oct. 20, 1914, and was practically ready for operation March 11, 1915. The Haigh continuous kiln, constituting this plant, is described in detail.

Russell T. Gray, Advertising Engineer

Russell T. Gray, formerly advertising manager of the Haynes Automobile Co., and more recently secretary of the Shuman Advertising Co., Chicago, has established an office in the First National Bank building, Chicago, as an advertising engineer. Advertising service will be rendered a limited number of clients in the technical field which will involve a broad knowledge of engineering sales problems, as well as of advertising. Technical advertising in trade papers and magazines, as well as all forms of engineering catalogs and direct-by-mail advertising will be handled.

The Great Western Smelting & Refining Co., Detroit, smelter and refiner of metals, now is located in its new warehouse, 709-719 Loraine avenue. This warehouse contains approximately 15,000 square feet and the railroad siding into the plant will accommodate four cars at one time.

School Foundry Makes Dummy Hand Grenades

How the Kansas State Agricultural College Filled an Order for Camp Funston, Thereby Facilitating the Training of Our Army

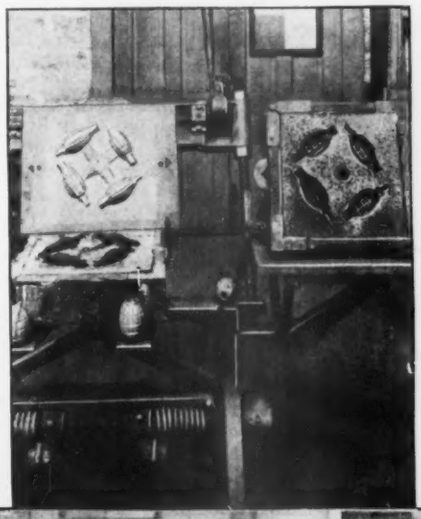
By Edward Grant

IN Peace times a college foundry would be the last place one would expect munition castings to be made, but in periods of war almost anything is liable to happen. For this reason the foundry department of the Kansas State Agricultural College, Manhattan, Kans., had an opportunity to cast dummy hand grenades for use at Camp Funston. These hand grenades are not filled with explosives, but merely are used for training purposes and are thrown from the trenches by recruits. Deliveries of grenades were not being received in satisfactory quantities from the firm with which the contract was placed by the government, and, therefore, we were asked to fill an order for 1000 grenades.

A French hand grenade was furnished from which the pattern was made. We cast an aluminum master pattern in halves from the sample purchased and this was used for making the necessary number of patterns for producing the matchplate. Four patterns, in halves, were mounted on a plate for the squeezer and the molds were made in a snap flask 12 x 12 x 4 inches. The patterns were split longitudinally and the grenades molded on their sides, although in some shops rifle grenades are being cast on end.

In the accompanying illustrations, Fig. 1 shows the squeezer on which the molds were made, with the drag half of the plate tilted and the drag half of the mold with the cores in position. At the right is shown the cope. It will be noted that these grenades are corrugated on the outside as contrasted with the rifle grenades which are corrugated on the inside. Fig. 2 is a view of the drag and cope halves of the mold and at the right is shown the cope side of the plate. In Fig. 3 is illustrated the mold ready to close. In all of these views samples of the cast grenades are shown.

An ingenious method of making the cores was followed, which might be adapted to advantage in other lines of work. One-half of the core was dry sand, a reinforcing wire having been inserted which was withdrawn after baking and which formed the vent. The other half of the core was made of green sand, paste having been applied to the dry sand core to make the two parts adhere. This core proved satisfactory and none of the castings were defective as a result of blowing. Of course, whole dry sand cores might have been made just as rapidly, but driers would have had to be provided and the dry sand cores probably would have been more difficult for the students to handle. The entire lot was made by boys who had little or no experience in molding and casting practice and the losses did not exceed 5 per cent. These were caused chiefly by the molds bursting from the pressure of the metal as no slip boxes or reinforcing frames were employed.



Ohio Safety Code Enforced

The safety and sanitation code for foundries and the rules governing the employment of women in core rooms became effective in the state of Ohio on Jan. 15. These standards were adopted by the Industrial Commission of Ohio, July 18, 1916, and were distributed among foundries throughout the state at that time.

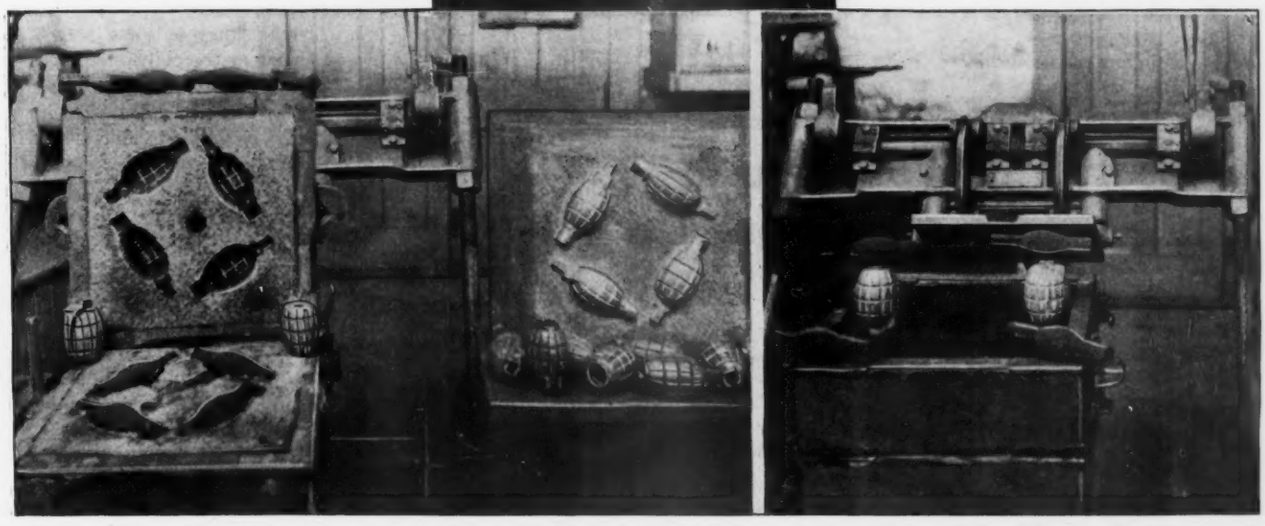


FIG. 1—SCHOOL EQUIPMENT FOR MOLDING DUMMY HAND GRENADES FIG. 2—MOLD FOR DUMMY HAND GRENADES READY TO CLOSE. COPE HALF OF PLATE AT THE RIGHT FIG. 3—MOLD FOR HAND GRENADES JUST BEFORE THE SNAP FLASKS WERE REMOVED

Metals Used in the Construction of Aircraft

What a Prominent Part Cast Iron, Semi-Steel, Aluminum, Brass and Bronze, Play in the Successful Building of Airplanes is Clearly Pointed Out by the Author

By Charles Vickers

IN THE early days of airplane development the impression prevailed that the enhancement of its flying efficiency, in large measure, depended upon the solution of problems connected with the synthesis of improved alloys of the metals of low specific gravity, notably aluminum and magnesium. We may congratulate ourselves that this impression was a mistaken one, as otherwise the science of air navigation would never have attained its present high state of efficiency. While new aluminum alloys have been introduced from time to time, the development of alloys of this element has failed to keep pace with that of the airplane. Aluminum alloys, of course are used in airplane construction wherever possible, as the saving of weight always will be an important consideration. However, this is not indispensable, and if the supply of aluminum suddenly failed, there is reason to believe that we would continue to have airships and that the development of this type of craft would still go on to ultimate perfection. All the commonly known metals and alloys enter into aircraft construction, including cast iron, semisteel, aluminum, brass, bronze, babbitt metals and special steels. Some builders prefer one material and others another, but it would seem from investigation that the iron foundry is getting more of the business than the brass or aluminum shop, as more engines are made with gray iron cylinders than with aluminum. If one part of the airplane may be considered more important than another, this particular position must be accorded the power plant. This is the part of the machine that contains the most metal and where castings are liable to predominate. The accompanying table shows the kind of metal used for the cylinders and other vital parts of a few typical American airplane engines. Of the 14 engines tabulated, the cylinders of five are cast iron, five forged steel, one semisteel and three aluminum. Adding the semisteel to the cast iron gives the latter type of cylinder a majority. Therefore, while the table does not include all types of airplane engines made in this country, it serves to give us a fair idea of the ranking position of cast iron as an aircraft material. It seems difficult to get along without this metal, whether in the construction of steamships, submarines, automobiles or airships. An interesting feature of construction of one of the engines is that the water jacket is made of electrolytically deposited copper, while another has a spun copper jacket, and another a steel jacket. The builder of one engine favors cast aluminum and, as a result, claims a low engine weight per horsepower. The cylinders, however, are steel-lined, which is customary with those of the cast aluminum type. However, no material may be regarded as standard for the construction of cylinders, or water jackets for airplane engines. For example, one engine has forged steel cylinders and aluminum water jackets; another has gray iron cylinders with spun brass water jackets, and the odd feature of the latter is that they are zinc plated. A patent recently has been issued covering a method of casting aluminum cylinders onto the steel liners, but the advantage appears to be with the removable steel sleeve, as this unit can be replaced when worn. The German Mercedes engine has built-up steel cylinders and is provided with acetylene welded pressed steel water jackets. The pistons are a combination of cast iron and steel forgings. The head of the piston, which carries the gudgeon pin, is steel and the skirt of the piston into which the head is screwed, is made of cast iron. The weight of the complete piston, with gudgeon pin and bush-

Metals Used in the Construction of Airplane Engines

Type of Engine	Metals Used in Construction
Aeromarine	Cylinders cast of a special grade of vanadium-treated cast iron. The water jackets are copper, electrically deposited after all machine work on the cylinders has been finished.
Christofferson	Cylinders of forged nickel steel, water jackets of aluminum.
Curtis	Cylinders of high carbon, drop forged steel; machined all over; Monel metal side wall brazed on; outside of cylinders heavily nickel-plated.
Duesenberg	Cylinders are semi-steel castings. An aluminum V-cover encloses the valve gear and helps to strengthen the engine.
Frederickson	Cylinders are cast iron. Crankcase is cast iron with nickel steel rings shrunk over each end.
General Ordnance	Cylinders are cast in pairs of *Lynite* (an aluminum alloy) and are surrounded by a water jacket.
Gyro-Duplex	Cylinders, steel, machined all over.
Orlo	Cylinders of special gray cast iron, cast separately and machined inside and out. Water jackets of spun brass, zinc-plated.
Packard	Built-up of alloy steel in blocks of three. The cylinder barrels are separately bored from solid forgings. Piston rings are aluminum.
Rausenberger	Cylinders of fine grained, annealed cast iron, with spun copper water jackets pressed on.
Roberts	Cylinders cast of special gray iron with water jackets integral. Pistons are aluminum.
Sterling Sunbeam	Aluminum crankcase.
Sturtevant	Cylinders are aluminum, cast in pairs and are fitted with steel sleeves. The cylinder heads also are cast aluminum; pistons, aluminum and the base, cast aluminum. Bearings are phosphor bronze and white metal.
Van Blerck	Cylinders are forged of special, high grade steel. Water jackets are spun copper. Bearings are high grade babbitt and babbitt-lined bronze shells are used.
Wisconsin	Cylinders, pistons and crankcase are cast aluminum. The cylinders are fitted with hardened steel liners, 1/16 inch thick and the iron valve seats are cast integral with the aluminum.

For some of the foregoing facts the author is indebted to *Aerial Age* and its editor, G. Douglas Wardrop.

FORMULAS FOR THE BRASS FOUNDRYMAN

Babbitt and Antifriction Metals

Genuine Babbitt for Heavy Service

	Per Cent
Tin	89
Antimony	8
Copper	3

Standard Genuine Babbitt

	Per Cent
Tin	89.00
Antimony	7.50
Copper	3.50

No. 1 Calumet and Hecla (Hard Babbitt)

	Per Cent
Tin	83.50
Antimony	11.00
Copper	5.50

Armature Babbitt

	Per Cent
Tin	87.00
Antimony	8.00
Copper	5.00

This mixture is softer than No. 1 Calumet and Hecla.

Motor Metal (Very Hard)

	Pounds
Tin	100
Antimony	10
Copper	10

Although babbitts with a tin base are expensive mixtures, there are many conditions for which their use is justified and no substitution can be made.

FORMULAS FOR THE BRASS FOUNDRYMAN

Babbitt and Antifriction Metals

No. 2 Calumet and Hecla

	Pounds
Tin	60.75
Antimony	10.50
Lead	25.00
Copper	3.75

Calumet and Hecla No. 2 is eminently adapted as a lining metal for large crankshaft and other bearings for corliss engines.

Babbitt Metal Cheaper than Calumet and Hecla No. 2

	Pounds
Lead	50
Tin	35
Antimony	15

Hard Lead

	Pounds
Lead	80
Antimony	20

Hard lead is improved considerably by the addition of a small percentage of tin and a reduction in the antimony, as follows:

	Pounds
Lead	80
Antimony	15
Tin	5

Babbitt Used on Marine Engines

	Pounds
Lead	72
Tin	21
Antimony	7

THE FOUNDRY DATA SHEET, FEBRUARY, 1918

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

ing complete is only eleven pounds.

The crank case of the Mercedes engine is cast aluminum of the following analysis: Copper, 4.22 per cent; zinc, 3.65 per cent; iron, 0.81 per cent; silicon, 0.96 per cent and aluminum, 90.36 per cent. The physical properties of this alloy, according to the British naval and military authorities, are as follows: Tensile strength, 20,954 pounds per square inch; yield point of 22,400 pounds per square inch for a sand cast aluminum bar usually is associated with a tensile strength of from 26,000 to 30,000 pounds per square inch or over. An elongation of 3.5 per cent also is average practice. An elongation of 4 per cent is associated with approximately 29,000 pounds tensile strength; an elongation of 10 per cent with 23,000 to 24,000 pounds tensile, and an elongation of 20 per cent with 19,000 to 20,000 pounds.

This German alloy is high in silicon and iron, and while it is impossible to obtain a commercial aluminum free from iron, this foreign alloy should be much better than this analysis would indicate. Some French aluminum obtained in prewar days contained silicon, 0.22 per cent, and iron, 0.27 per cent. An American aluminum of the same period was equally high grade and contained silicon 0.24 per cent, and iron, 0.25 per cent. Both these grades of aluminum contained a total of 0.49 per cent of impurities, but if a choice were to have been made between the two, the low silicon alloy should have been preferred.

A prewar German aluminum contained 0.72 per cent silicon and 0.81 per cent iron, and was about the same grade as that used for the crankcase of the Mercedes engine. This indicates, therefore, that the Germans are now making the same grade of aluminum as formerly, without access to the French bauxite deposits. It also indicates that they consider an aluminum of approximately 98 per cent purity as satisfactory for the base of the alloy composing the crankcase of their best airplane engine.

In duplicating this alloy the iron and silicon should be ignored and the copper should be placed at 4.5 per cent and the zinc at 5 per cent. The alloy, therefore, would analyze as follows: Aluminum, 90.50 per cent; copper, 4.50 per cent and zinc, 5 per

International Aircraft Standards

The International Aircraft Standards Board of the Advisory Commission of the Council of National Defense has formulated the following specifications for phosphor bronze castings for bearings, babbitt metal for bronze-backed bushings and soft solder:

Specifications for Phosphor Bronze Castings for Bearings

General.—1. The general specifications, 1G1, shall form, according to their applicability, a part of these specifications.

Use.—2. This material is suitable for liners in babbitted bearings.

Material.—3. The chemical composition shall be as follows:

	Per cent
Copper	79.00–81.00
Tin	9.00–11.00
Lead	9.00–11.00
Phosphorus	0.10– 0.30
Total impurities, maximum	0.25

Manufacture.—4. (*a*) The material shall be made from lake or electrolytic copper conforming to the I. A. S. B. specification 2N2 and from pig tin at least 99 per cent pure.

(*b*) No scrap shall be used other than that produced in the manufacturers' own plants and which is of the same composition as the material specified.

Workmanship and Finish.—5. Castings shall be homogeneous and free from shrinkage cracks, spongy spots, blowholes and foreign matter. Castings in which defects are revealed by machining operations shall be replaced by the manufacturer. The full weight of the original material in rejected castings shall be returned to the manufacturer.

Dimensions and Tolerances.—6. Castings must be true to pattern; cores must be correctly placed. Surfaces which are to be machined shall admit of finishing to the required dimensions without leaving any trace of the original surface.

Specifications for Babbitt Metal for Bronze-Backed Bearings

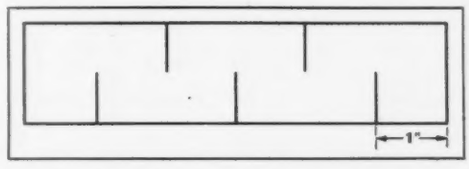
General.—1. The general specifications, 1G1, shall form, accordcording to their applicability, a part of these specifications.

Material.—2. The composition of the material shall be as follows:

Constituent	Desired per cent	Allowable variation per cent
Tin	91.00	90–92
Antimony	4.50	4–5
Copper	4.50	4–5
Lead, maximum	.20	...

Sample for Analysis.—3. (*a*) The inspector shall select one ingot from each lot of 25. The manufacturer shall melt this ingot in a clean ladle and cast therefrom one or more sample bars 6 inches long, 1 inch wide, and not more than ¼ inch thick.

(*b*) Saw cuts shall be made in each sample bar, as shown in the diagram below. The cuttings shall be thoroughly mixed and must be free from iron and dust. Samples for analysis shall be taken from the mixed cuttings.



Manufacture.—4. (*a*) The babbitt metal shall be made from lake or electrolytic copper conforming to the I. A. S. B. specification 2N2 and from the best commercial grades of tin and antimony.

(*b*) No scrap shall be used other than that produced in the manufacturers' own plants and which is of the same composition as the material specified.

Specifications for Soft Solder

General.—1. The general specifications, 1G1, shall form, according to their applicability, a part of these specifications.

Material.—2. Solder shall be made from new tin and commercially pure new lead. Its compositions shall be as follows:

	Per cent
Lead and tin, minimum	99.8
Tin	49 to 51
Antimony, maximum	10
Zinc	None

Delivery, Shipping and Packing.—3. Solder shall be delivered in 1-pound bars. The mark "Half and half" shall be cast on each bar. The bars shall be packed in boxes, the gross weight of which shall not exceed 220 pounds (100 kg.).

References.—4. United States Navy Department. Specification No. 47S7.

cent. The addition of 5 per cent zinc has a favorable effect upon the yield point of aluminum and also increases the tensile strength slightly, but lowers the elongation. In the foregoing remarks regarding tensile strength and elongation of aluminum alloys, except the German, reference is made solely to castings made in sand, without the addition of quick chilling ingredients, and that all tests were molded and cast alike, the test bars having been cast-to-size, with feeders on the ends of the grips and poured at a temperature of 750 degrees Cent.

Most of the steels used on the Mercedes engine were nickel alloys with a nickel content ranging from 2 to over 4 per cent. The timing gear wheel, which on one American machine is made of 10 per cent aluminum bronze, was made of steel containing over 4 per cent of nickel on the German machine. The camshaft housing cover on the latter was made of cast iron of the following analysis: Graphitic carbon, 2.97 per cent; combined carbon, 0.62 per cent; silicon, 1.81 per cent; manganese, 0.53 per cent; sulphur, 0.118 per cent, and phosphorous, 0.085 per cent. It will be noted in the accompanying table that one of the engines is fitted with high grade babbitt bearings and babbitt-lined bronze shells; another has phosphor bronze and white metal bearings. The latter, undoubtedly, were die-cast, while the bronze shells would be of a composition approximately as follows: Copper, 89 per cent; tin, 6.50 per cent; zinc, 3 per cent, and lead, 1.5 per cent.

In the construction of the lighter-than-air machines, aluminum has been used extensively by the Germans. The first builder of such airships was David Schwarz, of Berlin, who built two of this type which were unsuccessful. The hull framing of these aircraft was of aluminum tubing and the skin of aluminum sheets 2 millimeters thick. The airships were cylindrical in form and had pointed ends. The composition of the aluminum alloys used on these craft is not known, but it was probably similar to the metal employed in the construction of Zeppelins which consists of an alloy containing approximately 89.80 per cent aluminum; manganese, 0.50 per cent; copper, 0.70 per cent, and zinc, 9 per cent. A high grade aluminum was used in making this alloy, containing as a maximum impurity approximately 0.40 per cent iron and 0.40 per cent silicon, therefore having been more than 99 per cent pure.

Whether aluminum will be used extensively in the construction of gas-inflated aircraft is a question to be decided in the future. Structural airships, no doubt, will be used extensively, but wood, wire and fabric make a combination that aluminum will find difficult to outclass. For the power plants of this craft the same materials of construction will be used as are employed for airplanes. There is a possibility that the diesel engine will become the aircraft power plant of the future. Its advantage is that it requires no special ignition device, as the oil is ignited by the temperature attained by the highly compressed air. Such engines have been found on German aircraft, and should they prove to be successful for airship propulsion, it would mean a greatly increased consumption of nonferrous castings, unless some radical departure is made from the present type of construction.

Nonferrous alloys that have a bright future in the mechanics of air navigation are the aluminum bronzes and the brass founder who desires to keep pace with the march of progress, will make every effort to master the art of casting them. There are as many different alloys of copper and aluminum as there are of copper and tin. Aluminum bronzes can be made soft and ductile, or as hard as many kinds of steel. The alloy that enterprising airplane builders at present are most particularly interested in has a tensile strength of over 90,000 pounds per square inch, with an elongation ranging from 30 to 40 per cent.

This alloy is particularly resistant to vibratory stresses and it also runs fluid. Castings, ⅛ inch thick and under are being made of exceedingly complicated forms, weighing several pounds each. These castings are difficult to make, owing to the high shrinkage of the alloy. This is a property of the metal from which nothing can divorce it. However, the shrinkage may be overcome by the use of risers, by rounding off all corners on the patterns and by filling up all sharp crevices. No difficulty now is experienced with drossing of the metal, even when it is dropped into the mold, nor with porosity. This alloy has not yet been used in the construction of the power plant, other than in the form of brackets to support the engine. It is extensively employed for binding together the framework, especially on the large airplanes on which steel tubing is used. For this service aluminum bronze has proved advantageous, and while few details are available, it may be stated that its use is rapidly extending in this particular field, owing to the fact that it can be cast into thin and intricate shapes, has a high tensile and elongation in sand castings, and will not crystalize under vibratory stresses.

An accident that occurred some time ago to one of the larger hydro-airplanes proved the sterling qualities of aluminum bronze as a material for the construction of such craft. A large machine in descending crushed a wing and sank in 10 feet of water. The aviator was rescued uninjured and the machine was hauled out of the water by a derrick. Inspection developed that every part of the machine held together unusually well, and that as a result of its rugged construction and the excellent quality of the metals composing it, the damage to the aircraft was much less than anticipated.

In reviewing the short history of the airplane we are impressed by the fact that mastery of the air is being gained, not through the discovery of some wonderful new structural material in the field of metals, but by the use of the same materials that have made possible the locomotive, the steamship and the automobile.

Magnesium Manufactured at Niagara Falls

Prior to the war practically all of the magnesium used in the United States was imported from Germany, but since the stocks carried in this country were exceedingly small, it practically disappeared from the market entirely in less than 12 months and the price at which it was sold reflected its extreme scarcity. In January, 1917, the American Magnesium Corp. was organized at Niagara Falls, N. Y., for the purpose of building a plant for the manufacture of magnesium and magnesium alloys. These works now are in operation and are producing this metal in such large quantities that the price has been greatly reduced.

The principal uses for magnesium are for alloying with aluminum for airplane parts where lightness is essential. By the proper combination of magnesium, aluminum, and other metals in small quantities, an alloy can be produced, which will reduce the weight to nearly one-half that of No. 12 aluminum. Magnesium also is being employed more extensively as a deoxidizer and a scavenger for copper, brass, and bronze, and the American Magnesium Corp. has introduced a new magnesium alloy designed particularly for use as a deoxidizer for high-grade tool and alloy steels. In its powdered form, magnesium is used for making light bombs and flares for army use and these are employed by both the Germans and the allies for lighting *no man's land* on the European battlefields.

British Foundries Assign Heavy Tasks to Women

Their Duties Include Making Large, Heavy Cores and Molds —Their Capacity for Strenuous Work a Suprise to Employers

IS THIS war to sweep away one of our oldest traditions and render obsolete the term "the weaker sex"? The women of the European countries actively engaged in the war are at least doing their utmost to repudiate its application to them. In this country, although for a number of years we have seen women doing work ordinarily performed by men, it has been of a light character which imposes no serious tax on the strength of the workers. A large number of women are employed in our metal-working plants, operating the simpler machines and performing various tasks, such as the inspection and packing of finished products, in which their deftness and speed are used to advantage. Many foundries employ women for making light cores and in a few establishments they are working successfully as bench molders. However, concessions have always been made to their lack of strength and endurance. The American Foundrymen's association provides in its official safety code that no woman who is not in normal health may be employed in a foundry; furthermore, that no woman employed in a foundry may be permitted to lift unaided any object weighing more than 25 pounds. Up to date these safeguards have been considered necessary by the metal industries of this country to protect the women who are entering their ranks to take the places vacated by men.

In England, however, this solicitude for women workers necessarily ceased back in the first year of the war. While it is true that the health code for British munition workers provides that women shall be allowed periods of rest during the day, fixes the number of hours they may work during the week, and contains general regulations affecting the sanitary conditions in their places of employment, it does not define or limit the character of the work they may do. On the contrary, they are performing the heaviest of duties, such as breaking pig iron, loading slag cars, wheeling bricks, operating circular saws and taking full charge of power plants. Foundries are finding them especially valuable in molding, coremaking, and for grinding and sandblasting castings. They are employed on the latter operations in a number of British plants. Women are also charging cupolas and furnaces, piling scrap and operating cranes. In machine shops they turn shell blanks with accuracy and skill, setting their own tools with a precision which is remarkable.

The type of coremaking done by women in British foundries is very different from that usually assigned them in this country. Through the courtesy of the British ministry of munitions the accompanying illustrations are published, which show plainly the kind of work done by the women. Fig. 1 shows them making heavy cores in an English steel foundry. In this case, the weights they must lift do not seem to have impaired their constitutions to any great extent. In Fig. 2 women are handling ring cores 3 feet in diameter, each weighing, with the corebox, at least 350 pounds. Fig. 3 shows a woman crane operator handling steel scrap with a magnet.

Photograph Passed by British Ministry of Munitions

BRITISH WOMEN BUSY MAKING HEAVY CORES

Reports from the employers of women in the metal-working industries agree that they have proved surprisingly adept in learning the essentials of work which is entirely new to them. They are demonstrating every day that in many cases their fabled lack of strength is a myth. They are industrious, careful as to details, and produce accurate, finished work. In England, although conscientious for the most part with regard to attendance, they give some dissatisfaction on this score, due to the fact that

Photograph Passed by British Ministry of Munitions
WOMEN FINISHING A LARGE RING CORE

a small proportion of them are married and occasionally remain at home to attend to household duties. However, the tendency among factories to discourage the employment of married women keeps this objection to female workers from becoming serious.

The influx of women to places where they were never employed before has made one distinct contribution to industrial life in Great Britain. This is the attention which has forcibly been directed to conditions of shop hygiene and sanitation. War contracts have necessitated the construction of many new foundries and of additions to those already existing, and with the prospect of having to rely on female labor for some time to come, the plant owners have built these extensions according to the prescribed code for women workers, which is much more stringent than the factory regulations in force before the war. The buildings as a whole are now kept cleaner; ventilation, light and cleanliness are noticeably better, and more safeguards for workers are provided. As far as the women themselves are concerned, the higher wages which they now earn permit them to enjoy better living conditions than formerly, and as a matter of course, their physical condition reacts favorably to this situation.

Women Take Work Seriously

There has been nothing of romance in this translation of 1,000,000 British women from home-hearth to charging floor. In England the war has made such inroads on the ranks of industry that there is no longer any academic discussion about the efficiency of employing women—foundrymen, for instance, have to choose between using them or shutting down their plants. The government, of course, will not permit the latter, so in the British Isles there is really no alternative and more women are being employed every week on heavy foundry tasks. The women have responded to the call with enthusiasm, diligence and unselfish devotion, meeting all the demand of their new and strenuous occupations with the same spirit in which they had given their men to the war—as a matter of necessity, of course.

The United States will probably not be forced to impress its women for heavy foundry work to the same degree as England and France. To some extent, they are filling the gaps left by the first sweep of the draft, but only in the lighter branches of the trade. Doubtless they will never be called upon to pour castings or to operate heavy molding machines, but if the time comes when they are so needed they have before them in the performance of their British sisters an example of latent strength, skill and capacity which patriotism has disclosed.

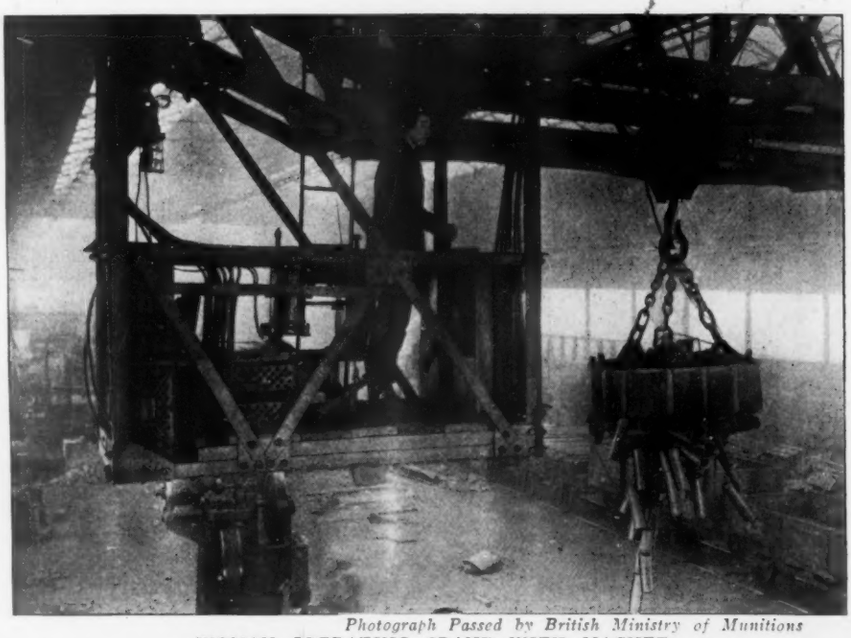
New England Foundrymen Elect Officers

At the annual meeting of the New England Foundrymen's association, held at Boston, Jan. 9, officers for the ensuing year were elected as follows:

President, George P. Aborn, Blake & Knowles Steam Pump Works, East Cambridge, Mass.; vice president, H. Paul Buckingham, Arcade Malleable Iron Co., Worcester, Mass.; treasurer, George H. Gibby, Gibby Foundry Co., East Boston, Mass., and secretary, Fred F. Stockwell, Barbour-Stockwell Co., Cambridge, Mass.

Executive committee: Charles A. Reed, Reed, Fears & Miller, Boston; Robert R. Newcomb, Deane Steam Pump Works, Holyoke, Mass.; A. N. Abbe, American Hardware Corp., New Britain, Conn.; A. B. Root, Hunt, Spiller Mfg. Corp., Boston, and W. J. Lavelle, New England Coal & Coke Co., Boston.

Frank D. Chase, industrial engineer, Peoples Gas building, Chicago, has been awarded a contract by the General Motors Corp., for the design and installation of the conveying and elevating system in the Marquette plant of this corporation at Saginaw, Mich.



Photograph Passed by British Ministry of Munitions
WOMAN OPERATING CRANE WITH MAGNET

Electric Furnace and Steel Converter Compared

Results Obtained by a Foundryman Who Has Had Experience in the Operation of Both Mediums for Cast Steel

By C R Messinger

THIS paper may be interesting for the reason that it represents what has been done in fairly well operated foundries and not what the designers of electric furnaces think ought to be, or can be done. The following remarks are not written with the idea of presenting anything new on the subject of the electric furnace, but rather to give some figures and facts based on about 13 months operation on one furnace and 15 months on another. From the first furnace during this period 2029 heats have been taken, and from the second furnace, 2436 heats. The furnaces referred to are of the single-phase, bottom-electrode type. The furnaces have been run on an acid lining except for a period of approximately one month, when one furnace was run basic.

Basic Operating Difficulties

In the writer's opinion, it is going to be difficult, if not impossible, to obtain satisfactory results from basic operation with this type of furnace. The single-phase, bottom-electrode furnace operates with a long arc, which means high voltage. The heavy slag in connection with basic practice refracts the heat from the long arc to the roof and side walls and causes them to melt in a very short time. The chief difficulty, however, is encountered in putting in a bottom of dead-burned magnesite or dolomite. A bottom of either of these materials should be sintered and with a water-cooled bottom electrode, this operation presents some difficulties. The electrode referred to is so placed that it projects through the magnesite, but cannot be used to form an arc with the top electrode to burn in the bottom for the reason that the bottom electrode is metal and thus easily melted. Should the electrode be melted too far, the water chamber would be exposed and the results would be disastrous. It may not be quite fair to make the statement that it is practically impossible to run basic with this type of furnace, but these were the conclusions reached after a month's trial on one furnace.

The furnaces described are called one-ton furnaces, but very rarely is there less than 2300 pounds charged and for periods of a month at a time charges weighing 3000 pounds have been used. The average charge for the furnace making 2029 heats is 2529 pounds and that of the furnace making 2436 heats, is 2780 pounds. An average charge on the first furnace is about as follows:

	Pounds
Contact plug	25
Shop scrap, 50 per cent of which is heads and gates from converter castings	1200
Shrapnel ends or axle butts	500
Structural punchings	350
Forging scrap, including flashings	300
Turnings	100
Total	2475

The average additions per heat have been about as follows:

	Pounds
Ferromanganese, 80 per cent	19.5
Ore	20.0
50 per cent ferrosilicon	13.5
Aluminum	1.0
Total	54.0

With this charge, steel can be made which will meet any specifications that the ordinary foundry has to contend with. The final chemical analysis, of course, can be varied by the final additions. The point which the writer is trying to bring out is that with the grade of scrap such as can be bought in any market, it is possible to produce satisfactory results, from a chemical and physical standpoint, on an acid lining.

During a period of 24 hours, it has been possible to melt and pour 12 such heats. Eleven heats during the same period is not unusual, but the best 30-day period shows an average of 9.24 heats per 24 hours. The melting time is approximately 2 hours and 15 minutes. The average charging time is 10 minutes.

Average Labor Cost

The average labor cost on a furnace of this type is $2.10 per net ton of steel melted and this figure covers bringing in the scrap from the yard, and as all repairing is done by the melters and helpers, this item is also included in this amount. The crew on the day shift consists of one melter, one helper and one man carrying scrap. The latter brings in enough scrap during 12 hours to supply the night shift also, so the night crew consists of one melter and one helper.

The consumption of electrodes on the furnace making 2029 heats in 13 months was 13,170 pounds, or an average of 5.15 pounds per ton of steel melted. In arriving at this figure breakage and a considerable amount of poor practice has been included. As graphite electrodes are worth approximately 13 cents per pound at the present time, the much talked of electrode cost amounts to less than 70 cents per ton of metal melted.

The cost which is generally considered first by the foundryman when considering the installation of an electric furnace is the cost of electric power used. This cost, of course, will vary according to the power rate and the kind of castings to be poured. The furnace described is used to pour very small castings with an average weight of less than four pounds; therefore, the furnace is not tapped until the metal is very hot and the power is left on longer than it would be in most foundries. The power consumption has averaged 635 kilowatt-hours per net ton of steel melted since installation. This figure is high for later practice and a figure of 570 kilowatt-hours can easily be made.

The refractory cost is more dependent upon practice than any other item, but even so, with ordinary skill can be fairly well controlled. To illustrate this, a few figures from the furnace charts will be interesting. They are as follows:

Roof No.	Life of roof, No. of heats
1	9
2	9
3	10
5	68
8	72
10	123
13	239
14	436
15	471
16	325

Since the melters have begun to appreciate the power behind the furnace, and eliminating the first nine roofs, the remainder show an average of 368 heats per lining. This resolves itself into a refractory cost of 7.8 cents per ton. Labor is not included in this figure, as it has been included in the melting cost of $2.10 per net ton melted.

Practically continuous operation can be maintained as the furnace does not have to be repaired oftener than once in six weeks, and by arranging for the shut-downs to come on Sunday, repairs can be started late Saturday and the furnace may be put in shape to run again by Monday noon, with an entire new lining and roof.

The maintenance of the electric equip-

From a paper at the Boston meeting of the American Foundrymen's association.

ment amounts to practically nothing and consists principally of keeping the switches clean. A plant having an electric furnace does not necessarily have to employ an electrician, as a little attention by the man who looks after motors, etc., will take care of whatever maintenance there may be.

It has often been stated that anyone could run an electric furnace and this, of course, is not true, as it requires a man with a good knowledge of metal. Of the four melters on these two furnaces two of them were converter blowers at the time the electric furnaces were installed. It can be said that any man with a good knowledge of metal can be taught to run an electric furnace in a very short time.

Scrap is an Important Factor

The writer has touched on practically all the items of cost which enter into making electric steel. It is apparent that the greatest variation in cost of making acid electric steel will come from the purchase price of scrap. However, the classes that can be used are so numerous that a reasonably low-priced mixture can be obtained in any foundry center. The reason for the miscellaneous mixture previously given is primarily to obtain a uniform analysis, as by using a number of different grades, when one car is finished, the substitution of a new car does not materially change the analysis. However, the question of the selling price of various grades of scrap has been taken into consideration in making up the mixture.

The power cost is next in importance, as an increase in the power rate of ¼ cent per kilowatt-hour will show an increase in the cost of castings of $2.65 a net ton, using a casting yield of 60 per cent and the average kilowatt-hour consumption mentioned. The plant with a rate of ¾ cent per kilowatt-hour will have an advantage of very close to $8 a ton in the cost of finished castings over the plant with a rate of 1½ cents per kilowatt-hour. The rate which the power company gives is important, but it is just as important, if not more so, that the central station be equipped to handle the load properly and give continuous service. It seems to work out in practice that the central station which does not have an excess of power cuts off the electric furnace load first when conditions arise where enough power cannot be furnished to meet all demands. It is also important that the rate be based on some schedule so as to give the plant the advantage of a lower rate when it furnishes a power company with a larger and more continuous load. In other words, a plant should have some consideration in rate for continuous operation to offset the disadvantages of night pouring. The labor cost, the maintenance, the electrode and refractory cost should be approximately the same in all localities.

The operation of the furnaces mentioned, one of which is run in conjunction with the side blow converter, shows that better foundry results are obtained in pouring small work with electric steel than converter steel. While it is possible to obtain any degree of temperature this side of the melting point of silica brick in the electric furnace, it is not difficult to obtain an even temperature over a number of heats. In pouring large work the advantage is not so apparnet, but it very often happens that when the foreman has a large, intricate casting to pour, one which might crack, he frequently requests that it be poured in electric steel. This is not an important factor, but it shows the attitude of the men who are dealing with both kinds of metal, day in and day out.

The present market price of low-phosphorus pig iron is such that a comparison of costs between the electric furnace and the converter is of little value. However, foundrymen are interested in the subject, as it has been claimed that the electric-furnace metal, in normal times, could be produced at a much lower cost than converter steel and as cheap as open-hearth steel. Enough figures have been compiled to show that in normal markets this statement is not entirely correct. Using the normal price of low-phosphorus pig iron, scrap, coke and a power rate which can be obtained in most large cities, the figures show that the electric furnace has a slight advantage so far as costs are concerned when compared with the converter. In making this comparison, the high original cost of the electric furnace has been kept in mind and the question of investment and depreciation has been considered. The comparative figures are so close that were the pig iron used in making the comparison put on an f. o. b. Philadelphia basis, the slight advantage would be with the converter.

A fact which may have a bearing on this subject in the future is that at present low-phosphorus pig iron is being produced in this country at a rate of 560,000 tons per year, whereas the production prior to 1915 was approximately 300,000 tons. It is just possible that this increased production, in normal times, will eliminate part of the premium that has been paid for low-phosphorus over bessemer iron. A change in conditions such as this would bring the two methods practically on an equal basis.

The situation sums itself up, that the farther west a plant is located the better comparative cost the electric furnace will make because of the freight rate on low-phosphorus pig iron and that there are certain points in the east where the question of an installation of an electric furnace rather than a converter would have to be determined on the basis of whether or not there was any difference in the quality of the metal produced.

One of the furnaces referred to in this paper is operating in the plant of the Sivyer Steel Casting Co., Milwaukee, and the other in the plant of the Electric Steel Co., Chicago.

Women in Industry

With the war constantly decreasing industrial forces, employers are giving more serious consideration to the problem of hiring women to fill the gaps. Although women have been extensively employed in foundries and elsewhere in England since the first year of the war, their introduction into industry on a large scale in this country involves considerable readjustment and the solution of numerous perplexing problems. These problems, however, are receiving the attention of some of the most widely experienced organizers and industrial managers in the country.

In this connection, C. E. Knoeppel, of C. E. Knoeppel & Co., efficiency engineers, New York, has sent a questionnaire to 1000 manufacturers in the hope that the data obtained may throw some light on the problem of successfully employing women in foundries and other industrial establishments. The questions are as follows:

1.—How are we going to find the immense army of women needed?
2.—What basis shall we use for selecting women for industrial work?
3.—What efforts shall we make to provide clean, wholesome living conditions?
4.—What changes will we have to make to provide proper working conditions?
5.—What social conditions will we have to provide?
6.—What hours should women work, and how about rest periods, fatigue and the like?
7.—How will we subdivide and arrange the operations so that women can efficiently perform them?
8.—How will we train women and who will do it?
9.—What steps will be necessary to induce the full co-operation of (a) labor unions, (b) organizations of women, (c) our government?
10.—What steps should be taken to change and unify the state laws with reference to women's labor?
11.—How shall we adjust and arrange the wages of women?
12.—What will we do with reference to women's labor after the war?

Readers of THE FOUNDRY who are in a position to answer any of the foregoing questions are requested to communicate with Mr. Knoeppel.

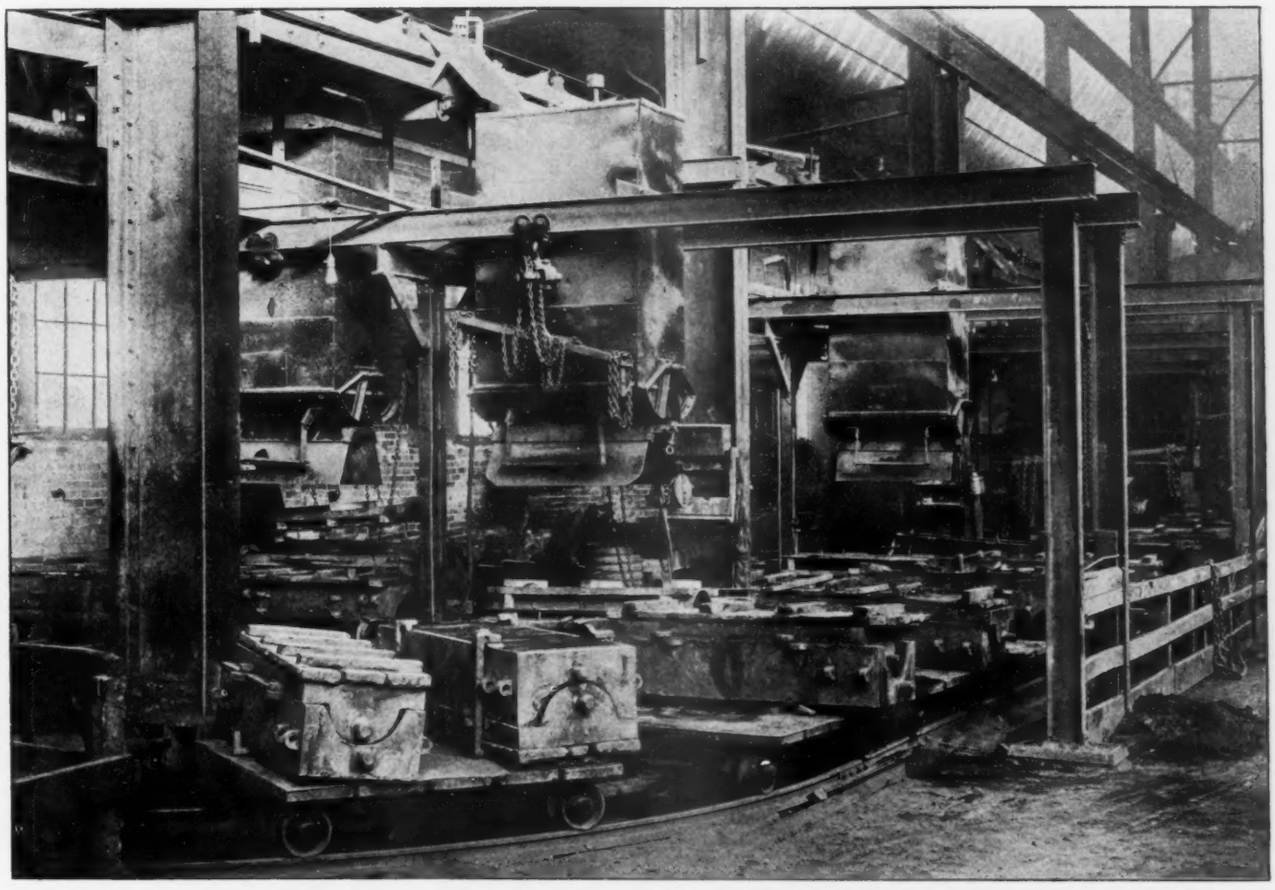


Fig. 1—General View of Mold-Conveyor from North End

Casting Pipe Sections by Continuous Pouring

Unique Pouring and Conveying Systems Installed in Foundry of American Road Machinery Co., Eliminate a Large Number of Workmen

CONTINUOUS molding and pouring is becoming increasingly popular for foundries producing standardized castings in large quantities. This system not only makes it possible to secure a large output in a relatively small floor space, but also greatly reduces the labor ordinarily required to handle and truck material. The existing scarcity of labor makes the use of sand and mold conveyors, as well as the other elements of the continuous system, doubly effective at this time. Many new foundries are being built and equipped with apparatus for continuous molding and pouring; at the same time, the conditions enumerated also have made it desirable in certain instances to remodel old plants for continuous operation.

A case in point is the foundry of the American Road Machinery Co., Delphos, O., which has recently been completely re-equipped for the continuous manufacture of cast-iron culvert-pipe sections. In carrying out this reconstruction, a number of interesting features were developed which it is the purpose of this article to discuss.

Fundamentally, the method of solving the problem at Delphos was similar to that employed by the Westinghouse Electric & Mfg. Co. in working out the design of its new continuous foundry at Cleveland, except that a mold conveyor also has been introduced. In fact, Ira Cole, superintendent of the foundry of the American Road Machinery Co. at Delphos, states that he obtained the original inspiration leading to the construction of his new facilities from the articles describing the Westinghouse installation published in the April, 1916, issue of THE FOUNDRY.. In planning the equipment at Delphos, Mr. Cole received the co-operation of E. E. Berry, superintendent of the Ft. Wayne, Ind., plant of the American Road Machinery Co.

The plant at Delphos was erected about 12 years ago by the Delphos Foundry Co., manufacturer of foundry equipment. This concern later dissolved and the shop passed eventually into the hands of its present owner. The foundry proper is 60 x 220 feet. A large number of castings for road and farm machines is turned out, but the continuous system recently installed is devoted exclusively to the production of culvert pipe sections.

Floor Space Was Inadequate

Before the new pouring and conveying system was introduced into the Delphos plant, the heads of the company realized that a large overhead expense could be eliminated in the pipe-casting department and much more work accomplished, if machines could perform some of the work done by hand labor. Skilled molders are unnecessary for making these pipes which are cast in half sections split axially, thus requiring the use of only one simple pattern and no cores. Under the old system, molds could be turned out so rapidly that all the stor-

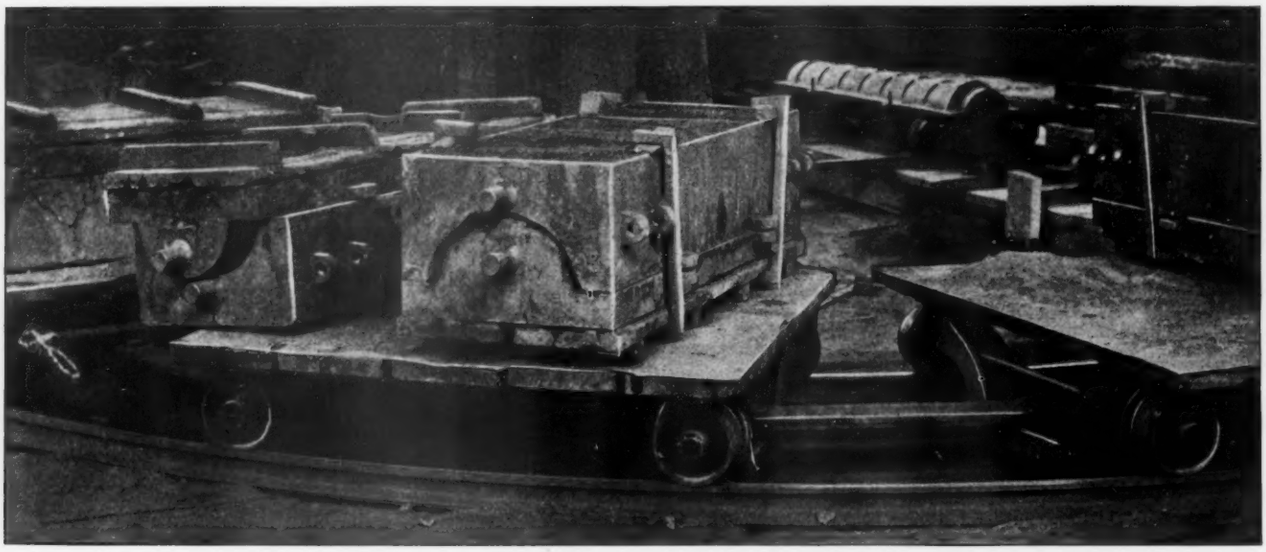


FIG. 2—CLOSE-UP VIEW OF CAR LOADED WITH PIPE SECTION FLASK

age space on the molding floor and all the flasks would be used up long before pouring time arrived. Difficulties also were met with in shaking-out the castings, in carrying them to the dipping shed and in working over the large quantities of molding sand necessary for the operation of the plant.

As previously suggested, the apparatus installed in the pipe-casting department to secure continuous operation consists essentially of an endless mold conveyor, with suitable molding, pouring and shaking-out stations; a complete sand-handling and renovating system, and equipment for handling the finished product.

The track forming the foundation for the mold-conveying system is laid in the form of a loop 138 feet long with parallel sides and curved ends. It accommodates 42 small flat cars with 50 x 54-inch platforms. The cars, which are coupled in a continuous train, move at a constant speed of nine feet per minute, and except for emergencies, never stop from the time the shop opens at 6:30 in the morning until the men cease working at 4 o'clock in the afternoon. Fig. 1 shows a general view of the conveying system from the north end, while Fig. 2 shows a more detailed view of the cars.

Doubtful as it may seem, the 42 cars

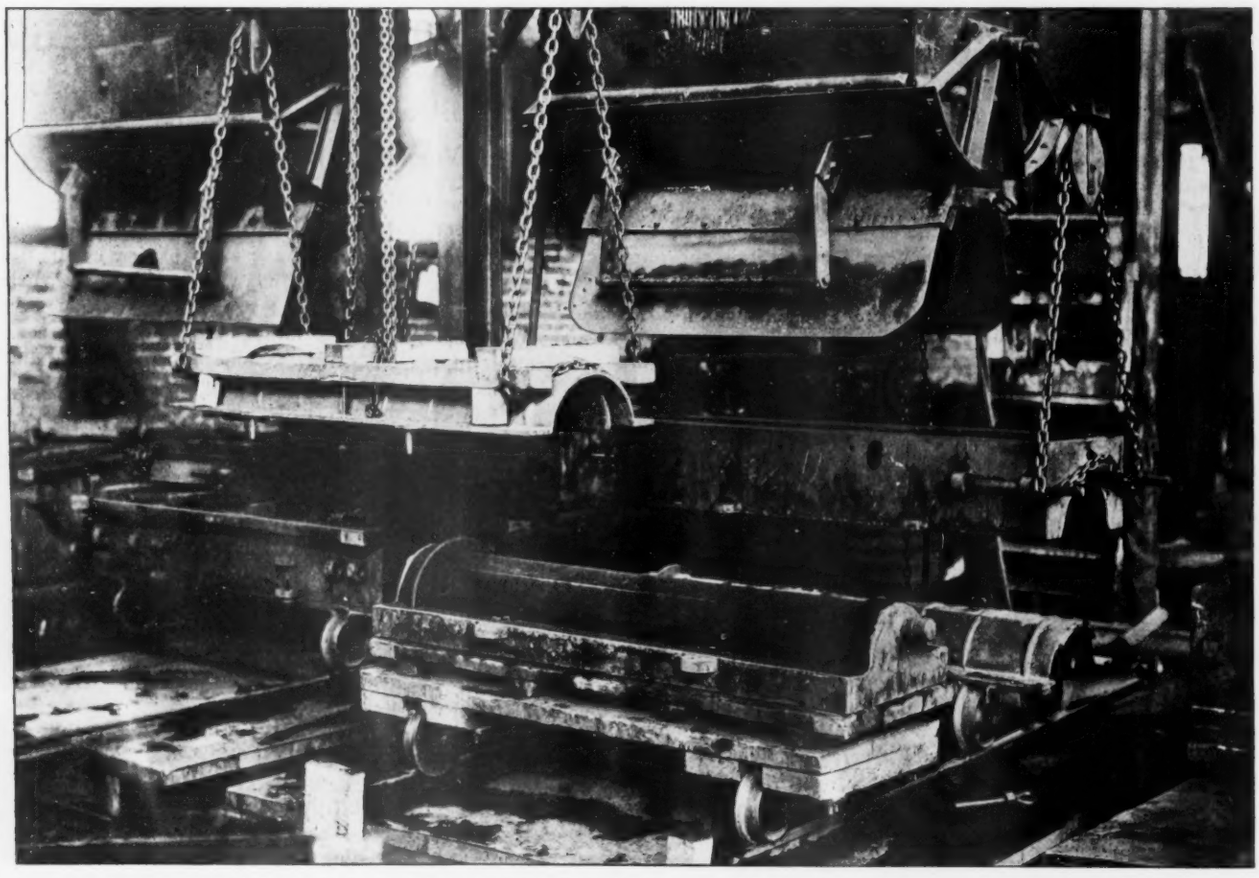


FIG. 3—THE MOLDS ARE MADE ON FLAT CARS—THE SAND IS SECURED FROM THE OVERHEAD STORAGE BIN

on the track and an overhead sand conveyor, which will be described later, require only one 7½-horsepower motor for their operation. It is said that the speed of nine feet per minute could be materially increased without necessitating any increase in the size of the motor. The motor, which is located on a platform near the top of the building, is belted to a shaft about 15 feet below. This shaft is located at the south end of the mold conveyor. The shaft carries a worm which drives a large gear with a reduction of 47 to 1. Located on the same shaft with the gear is a 12-tooth sprocket wheel. It is the first of a set of wheels of the same type which operates the sprocket chain that keeps the cars in motion. In order to give the cars a secure foundation a third rail has been laid in the middle of the track, against which cast-iron guide wheels run. Two guide wheels are fixed to each car.

The tracks undergo considerable expansion and contraction from summer to winter. A special device operated by jacks has been installed to compensate for this variation. A concrete pier runs across the floor from the outer edge of one track to the outer edge of the other. The rails are broken at this point and connected by adjustable fish plates. Attached to all four rails and running parallel to the concrete pier is an I-beam. Two jacks are placed between this beam and the pier. When the rails begin to contract in cold weather, the entire north section of the track may be moved back to its normal position through the medium of the jacks. In hot weather, when the rails expand, they are worked back by the pulling action of the cars.

Preparing the Molds

The molds are prepared in the enclosure within the tracks, two men working beneath each sand storage bin. As shown in Fig. 3, the molds are made on flat cars which rest on standard gage tracks. One man rams the cope and the other the drag. Sand is secured from the overhead storage bin by opening the gates operated by the long handle shown in the illustration. On leaving the bin the flow of the sand is controlled by a sheet-iron guide by means of which it may easily be directed into the cope or drag as desired.

The work is so arranged that the two men working on the same flask finish their individual operations simultaneously. Thus without wasting any time the cope is set in position on the drag, the clamps are put on and the entire flask lifted onto a vacant car in the conveyor train

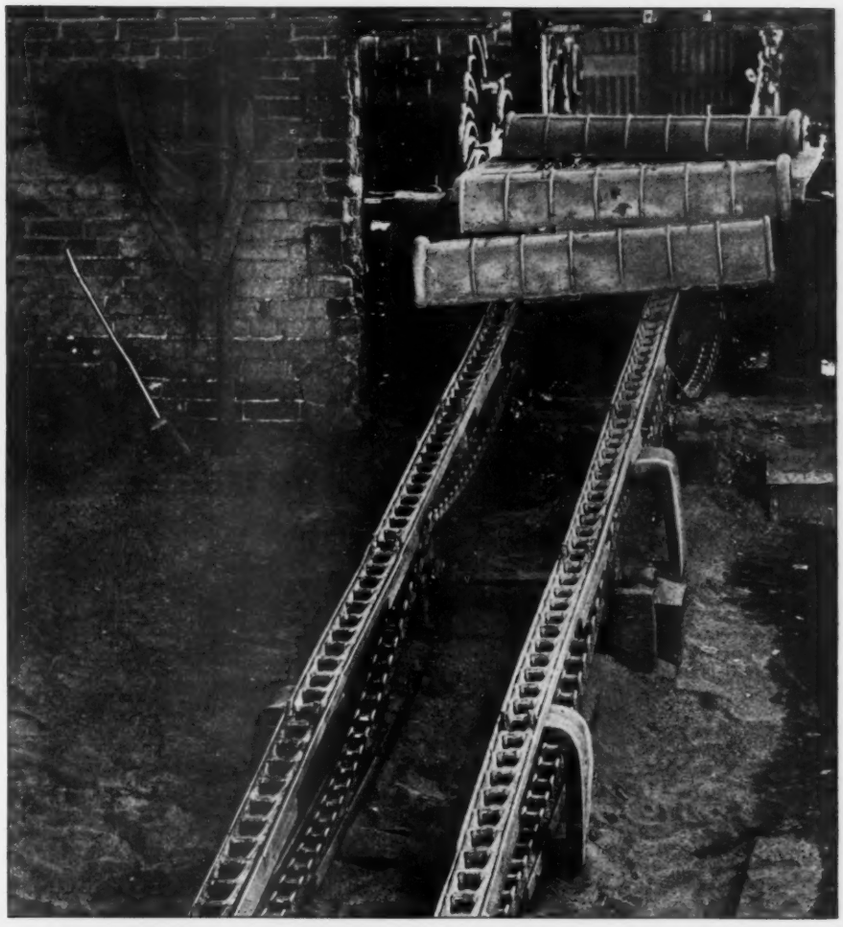


FIG. 4—CONVEYOR TRANSPORTING CASTINGS FROM SHAKING-OUT PIT TO DIPPING ROOM

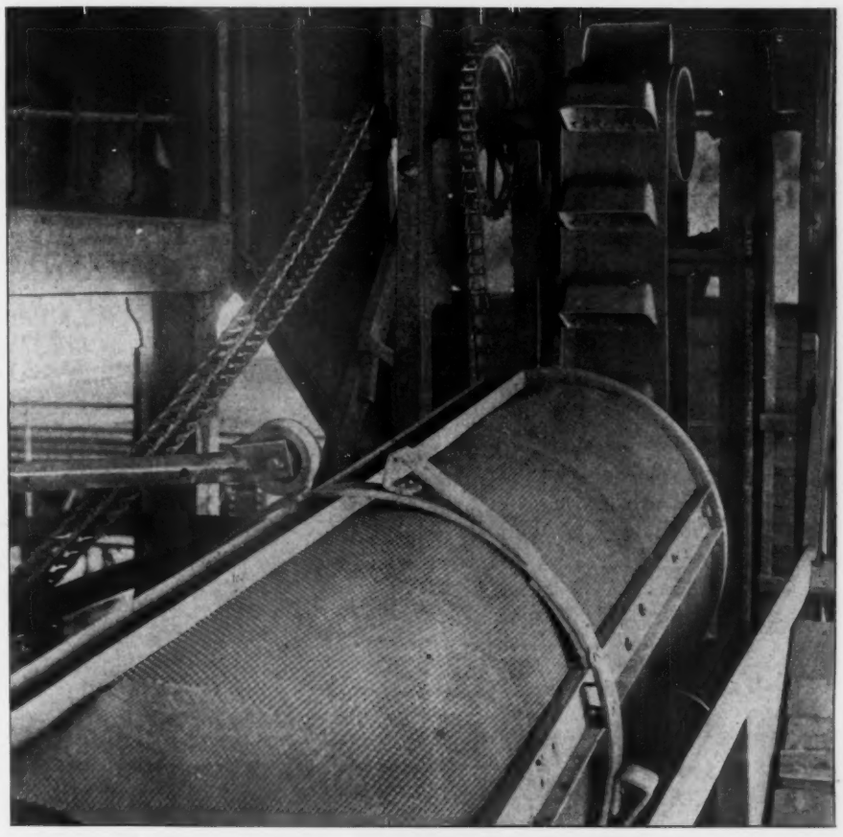


FIG. 5—TOP OF THE SAND ELEVATOR—THE SAND IS DISCHARGED INTO THE REVOLVING SCREEN

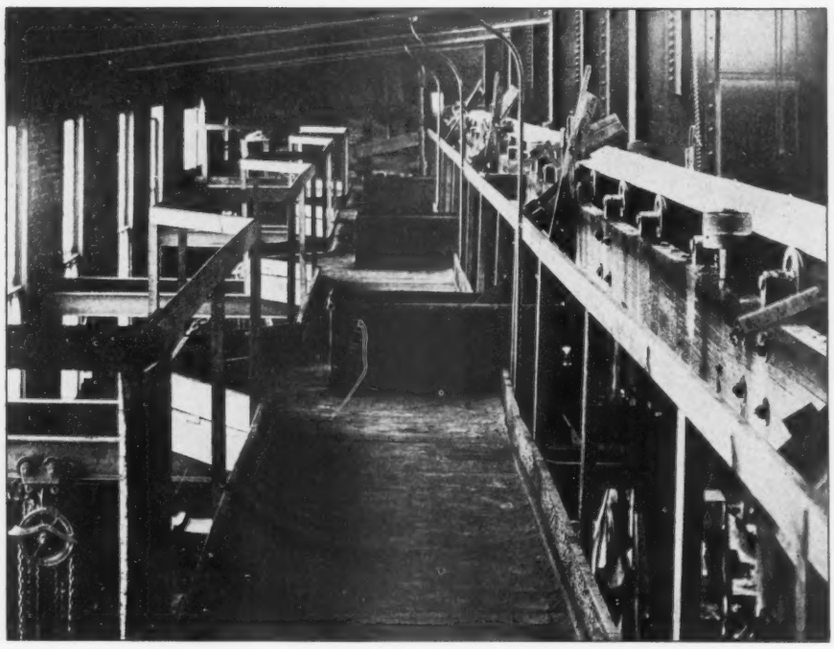


FIG. 6—CONVEYOR CARRYING SAND TO STORAGE BINS

with a hand-operated chain hoist. As soon as this operation is completed, an empty flask is taken off one of the cars returning from the shaking-out station and the cycle is recommenced. It has previously been stated that skilled molders are unnecessary for this work. Some men, in fact, attain sufficient proficiency to handle the work and make good molds in a single day.

The hand hoists, 16 of which are employed, were furnished by the Chisholm & Moore Mfg. Co., Cleveland. Pneumatic sand rammers were furnished by the Ingersoll-Rand Co., New York.

When the system is working to capacity every car on the conveyor from the last molder on around to the shaking-out pit is occupied by flasks. The castings are poured opposite the cupolas or immediately after the cars have passed the last two molders. Pouring operations start virtually with the 6:30 o'clock whistle. The metal enters the casting through two runners, a specially designed long trough-shaped ladle with two lips being employed for this purpose. The sprues are knocked off almost immediately after the castings are poured and before they are shaken out. After the metal is poured the flasks traverse slightly more than half the conveyor, about 160 feet, to reach the shaking-out pit. As the cars move at a speed of nine feet per minute, the castings reach the pit about 20 minutes after they are poured.

Shaking Out Castings

The shaking-out pit is shown in Fig. 7. The flasks which weigh slightly over 1200 pounds, are transferred from the cars to the shaking-out rails, also shown in Fig. 7, by means of an air hoist. In rapid succession, the clamps are knocked off, the cope is lifted from the drag and placed to one side and the drag is inverted, causing the casting to fall out. Unless defective, the casting is

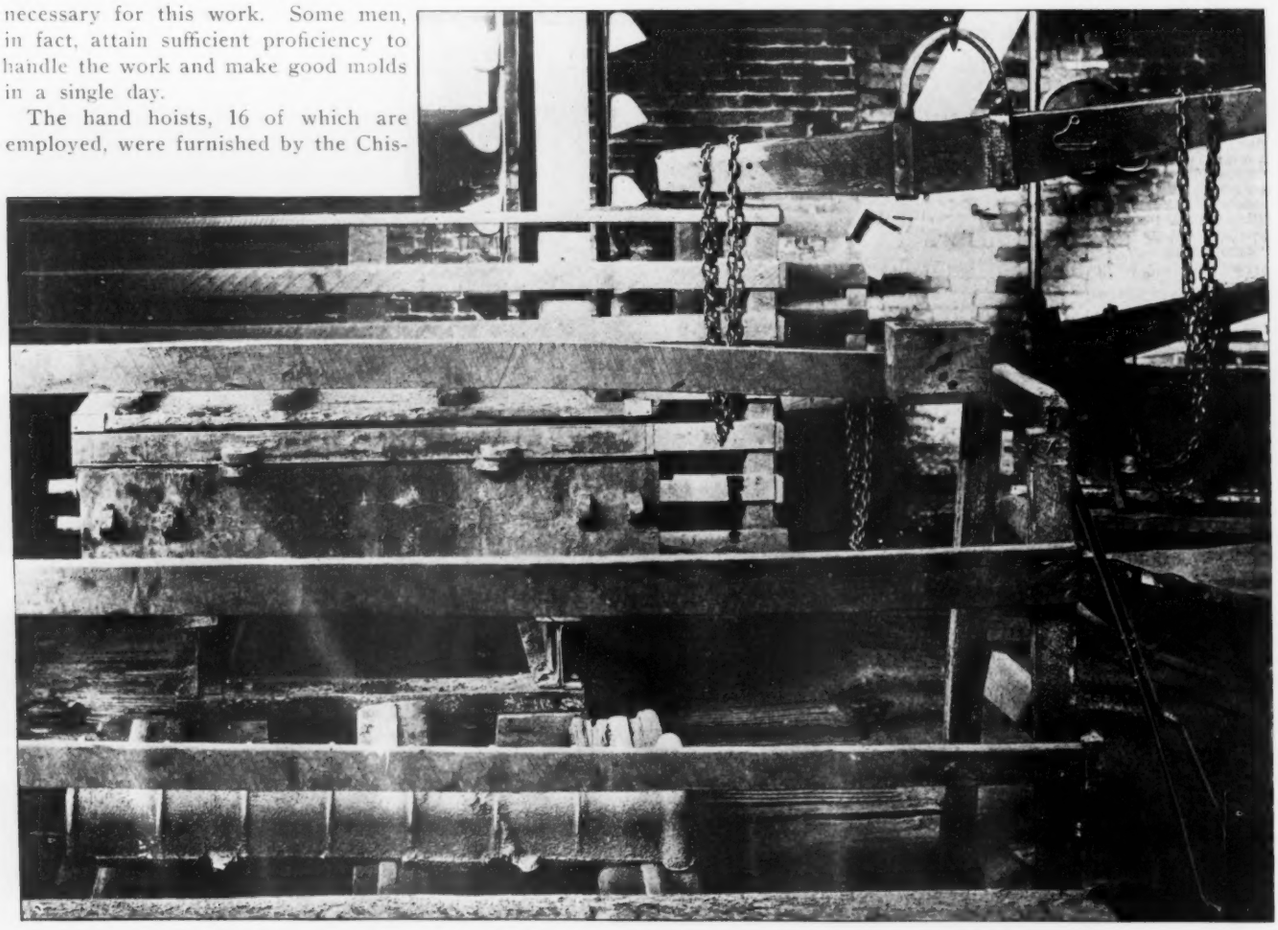


FIG. 7—SHAKING-OUT PIT—THE SAND FALLS THROUGH THE GRATING ONTO A CONVEYOR WHERE IT IS RELAYED INTO THE BUCKET ELEVATOR—FROM THIS POINT THE CASTINGS GO TO THE DIPPING ROOM

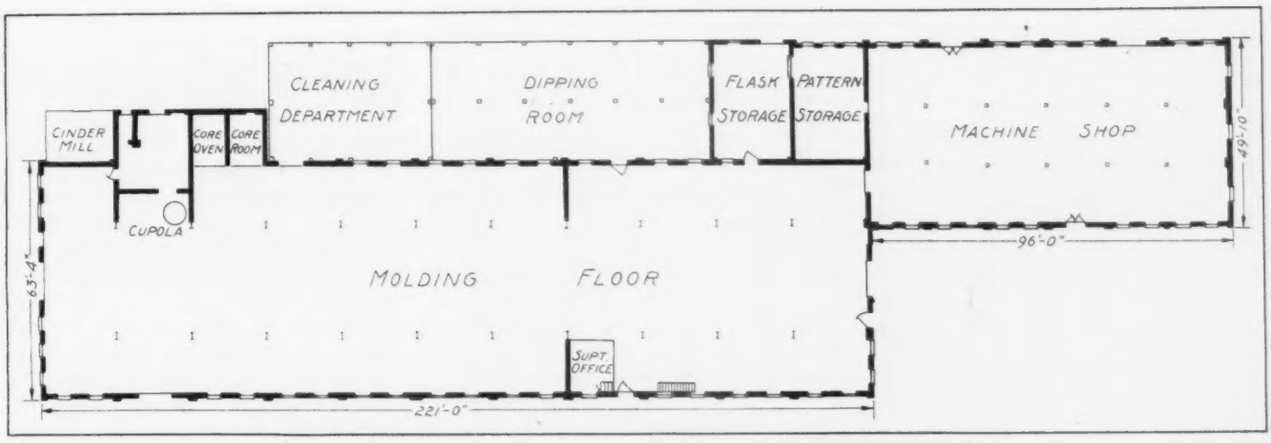


FIG. 8—PLAN OF FOUNDRY OF AMERICAN ROAD MACHINERY CO.

immediately pushed down a second set of rails which terminates in a traveling conveyor leading to the dipping room. This conveyor is provided with chains equipped with lugs spaced at regular intervals which carry the pipe sections along. While the castings are in motion the sand is rubbed off with long-handled steel wire brushes.

How Pipes Are Dipped

When the castings reach the highest point in the conveyor, they traverse a short level space before descending into the hot pitch bath, in which they are totally submerged for about three minutes. Still being carried forward by the conveyor they rise out of the bath and are finally deposited on a platform. They are immediately lifted by an air-hoist equipped with special tongs to allow the surplus pitch to drain off.

The tar in the bath is kept in a molten condition by means of the hot castings. No other heat is necessary. Even when work begins in the morning, and the pitch has become entirely cold, it is not artificially heated. When the transfer truck is loaded with coated pipe sections it is wheeled out into the yard where the castings are placed on storage piles alongside the railroad.

To return once more to the shaking-out pit, it was mentioned that the cope is pushed to one side until the pipe section is dropped out of the drag and started on its way to the dipping room. The sand is shaken-out of the drag at the same time. It is also knocked out of the cope and the empty flask is again united and transferred by means of the air hoist to a vacant car on which it is returned to the molders.

The sand falls through a grating into a hopper which leads to a belt-conveyor. New sand is also added at the grating. Owing to the character of the work, however, but little new sand is necessary. Frequently only one wheelbarrow load is required in an entire day. This is the only operation in the whole process which necessitates handling the sand.

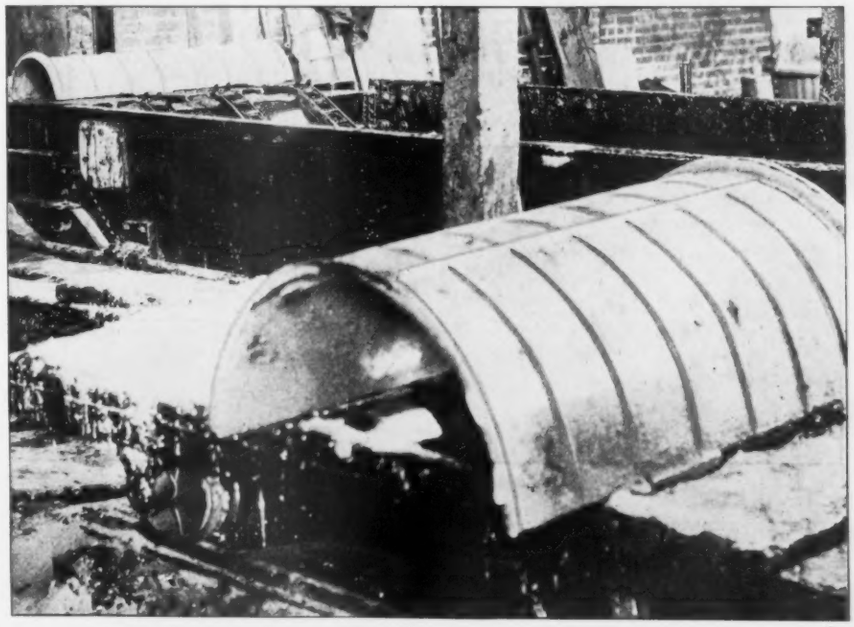


FIG. 10—A VIEW IN THE DIPPING ROOM—THE CASTING IS ABOUT TO ENTER THE BATH

The belt conveyor under the receiving hopper, which is about 12 feet long, discharges the sand into a chute which leads in turn to a bucket ele-

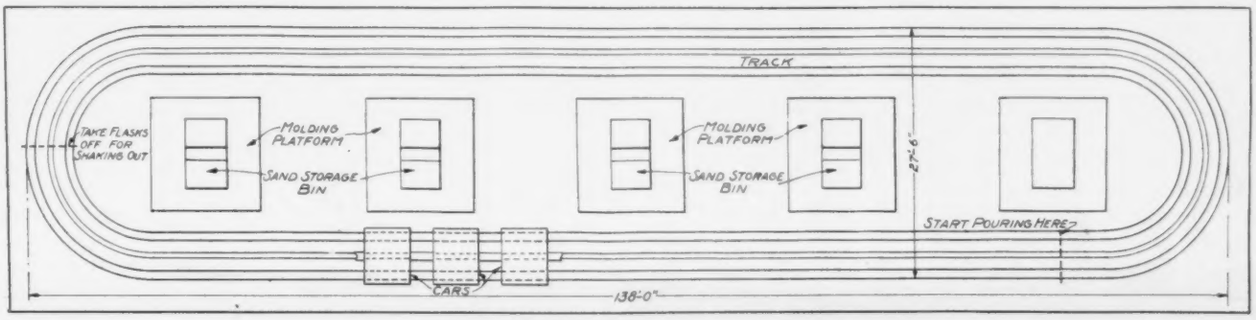


FIG. 9—A GENERAL VIEW OF THE CONVEYING SYSTEM

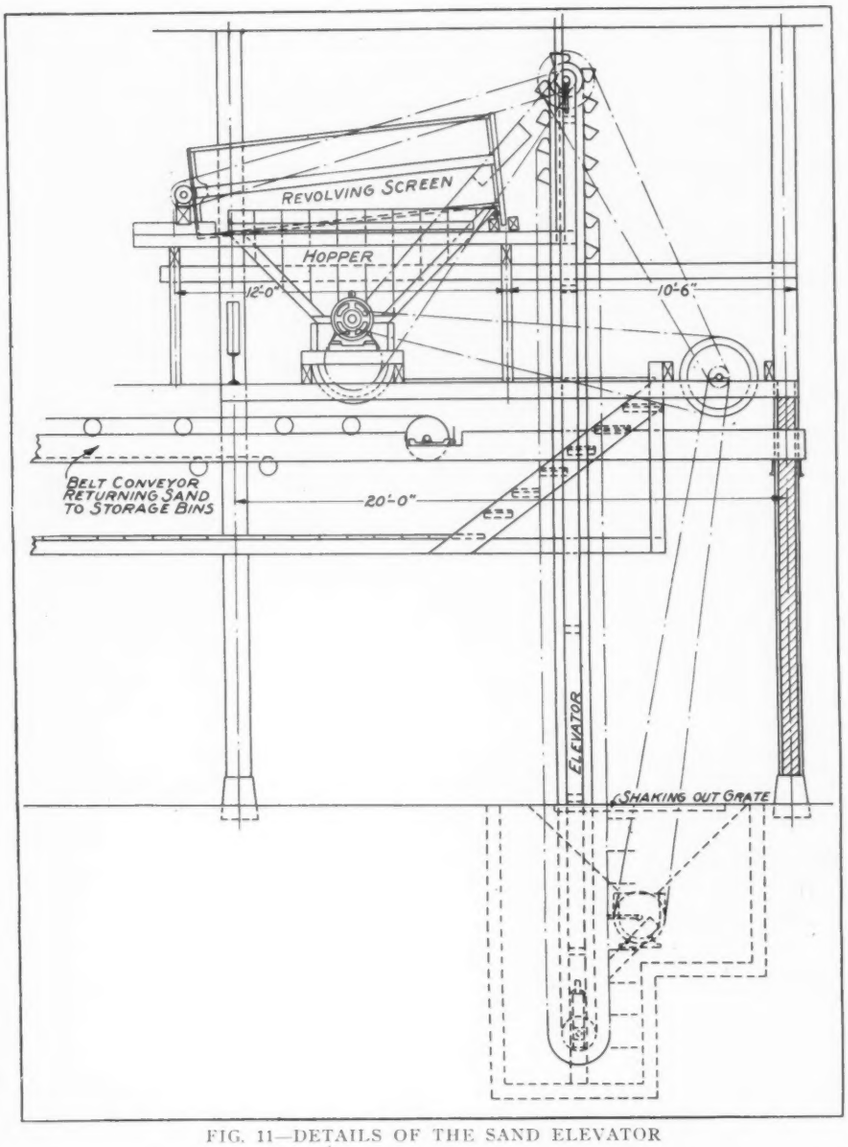


FIG. 11—DETAILS OF THE SAND ELEVATOR

vator of simple construction. This elevator in fact is nothing more than a canvas belt equipped with buckets spaced a foot apart. It is 35 feet in height and has 72 buckets. Details of its construction are shown in Fig. 11. The general progress of the sand is also indicated by this illustration. The sand is discharged from the bucket elevator into a rapidly revolving fine mesh screen. After being sifted through the screen it drops into a large hopper which tapers down to an opening approximately 12 x 18 inches. The latter leads to a spiral mixer. This mixer is equipped with throw-back blades and narrow-edged spirals in order to insure both ample mixing and slow discharge onto the rubber belt shown in Fig. 6. The belt is the last unit to handle the sand before it is returned to the storage bins over the molders' stations. This belt is driven by the same motor which drives the mold conveying cars. The sand is guided into the molders' bins by means of the cut-offs shown in upright positions in Fig. 6.

As previously pointed out, the whole system is in continuous operation throughout the entire day. To make this possible, no special lunch period is observed by the men, but they are granted 15 minutes whenever they are best able to spare it.

Two cupolas working on alternate days are employed. The smaller one melts about 25 tons of metal daily. It was built by the Delphos Foundry Co., the original owner of the plant. It was designed to burn fuel oil instead of coke, but when the foundry passed into the hands of the American Road Machinery Co., suitable alterations for burning coke were made. The larger cupola melts over 40 tons daily. It was built by the Northern Engineering Works, Detroit. Inasmuch as the average daily metal requirements are almost 35 tons, the work is so distributed that the heaviest castings are made on the day the large cupola is in operation.

The continuous system for molding pipe sections occupies only part of the molding floor. The remaining space is devoted to the production of the many intricate castings necessary for the road and farm machines which constitute the primary product of the company. The arrangement of these floors is indicated in the plan of the foundry, Fig. 8. They are served by an electric traveling crane of five tons capacity made by the Toledo Bridge & Crane Co., Toledo. Two hand-operated cranes likewise serve the molding floors, but they are intended more particularly to meet emergency requirements.

Each cupola has its own charging floor. This unusual arrangement was necessitated by the difference in the size of the two units. The charging door on the large cupola is fully eight feet higher than that of the smaller. The coke, limestone and pig iron are hoisted on a 4000-pound elevator furnished by the Warner Electric Co. Small industrial cars running along a narrow-gage track are used to carry the charging materials. A small turntable is placed approximately five feet in front of the charging door. Here the cars approaching the cupola from the elevator may be switched to another track and wheeled back into a temporary storage space. Each charging floor accommodates almost a day's supply of materials.

Cleaning Department

In the cleaning department, two large tumbling mills furnished by Frederic B. Stevens, Detroit, meet the entire requirements. The blower for this department, raised about 10 feet above the floor, was furnished by the B. F. Sturtevant Co., Hyde Park, Mass. The dust catcher was constructed by the American Road Machinery Co.

Iron in the cupola drop is recovered by a cinder mill made by the W. W Sly Mfg. Co., Cleveland. It is located in a small shed at one side of the cupolas. The core oven is of the car type and was, like the small cupola, constructed by the original owner of the plant, the Delphos Foundry Co. Blast for the cupola is furnished by a blower made by the P. H. & F. M. Roots Co., Connersville, Ind. It is driven by a 35-horsepower Westinghouse motor.

Only a small machine shop is provided, principally for repair work. Practically all the castings made at the Delphos foundry are shipped to the plant at Fort Wayne for machining.

Metal Salvaged From the Scrap Pile in 1916

The Value of Such Secondary Recoveries Year Before Last Was More Than Double That of 1915 and the Quantity Also Was Increased

SECONDARY metals, exclusive of gold, silver, platinum, iron, steel and ferroalloys, recovered in the United States increased from $114,304,930 in 1915 to $265,377,856 in 1916. According to the report on "Secondary Metals Recovered in 1916," by J. P. Dunlop of the United States geological survey, this added value partly was due to the increased use of these materials and also to the higher average prices that prevailed in 1916. The value of secondary platinum, iridium and palladium recovered in 1916 amounted to about $4,000,000 and the value of old jewelry, dental waste, ornaments and other material containing gold or silver remelted and refined, probably was more than $20,000,000. It is difficult to estimate the value of ferrous scrap remelted in 1916. Some of the scrap ferrous metal contained nickel, tungsten, manganese or other alloys which made it many times more valuable than the more ordinary commercial products. Old rails, car wheels, pipe and other iron and steel shapes often were sold at prices in excess of the original cost. The prices of all other waste materials has increased so greatly that the total value of waste metals and other junk was 100 per cent more in 1916 than in 1915.

Recovery of Metal From Dross

This report states that more than 90 per cent of the refining and smelting of drosses and scrap metals in this country is confined to the territory east of St. Louis and north of the Ohio river. About 43 per cent of the secondary aluminum was reported from the states of Ohio and Michigan; 27 per cent from Illinois and Wisconsin, and 18 per cent from New York, New Jersey and Massachusetts. Smelters and refineries in St. Louis and Chicago recovered about 37 per cent of the antimony in alloys and those in New York and Philadelphia, about 45 per cent. The largest recoveries from tin dross, tin scruff, and clean tin scrap were made in Pennsylvania, New York and New Jersey. Nearly all of the secondary nickel was reported from Connecticut. However, the recoveries of lead, zinc, brass, and copper and of such alloys as babbitt, bronze, and pewter, were more generally distributed.

The total quantity of secondary copper recovered in 1916, on the assumption that the brass remelted had an average content of 70 per cent. was 350,000 tons. Of this total, 52,212 tons were recovered by plants refining primary metals and the remainder by plants treating only secondary materials. The copper produced by smelters of the latter class include 74,100 tons of pig copper, 14,000 tons of copper in alloys other than brass, and 210,000 tons of copper in remelted brass. These figures indicate an increase for 1916 of about 20,000 tons of pig copper, 113,750 tons of copper in brass and a decrease of about 2000 tons in alloys other than brass. At least 175,000 tons were recovered from clean scrap made in the course of manufacture of copper and brass ware, so that less than 175,000 tons were obtained from ashes, cinders, and scrap, or from material that actually had been used and discarded. According to the reports received it is evident that there was an increase in the quantity of old scrap, brass, and copper smelting and a much larger proportionate increase in the quantity of clean, new scrap remelted. The reports from rolling mills, munition factories and other users of brass showed enormous increases in the quantity of clean scrap remelted. The increase in the quantity of scrap brass used amounted to 162,000 tons and of this increase at least 100,000 tons were clean new punchings, filings and clippings. The value of the secondary copper recovered was estimated at $68,880,000, having been computed at the average yearly price of 24.6 cents per pound. For the calender year 1916 the imports of copper and brass scrap total 22,982 tons.

Many railroad companies sell or turn in the larger portion of their brass and copper scrap, and other metal waste, to dealers in part payment for new material, but the reports received showed that the railroads utilized in their own shops and foundries more than 14,000 tons of brass in addition to 950 tons of copper and 3000 tons of copper in alloys other than brass. The production of copper from secondary sources in 1916 was equal to about 31 per cent of the refinery output of primary copper in the United States from all sources, or about 37 per cent of the primary copper smelted from domestic ore.

QUANTITY AND VALUE OF SECONDARY METALS RECOVERED IN THE UNITED STATES IN 1915 AND 1916

	1915 Quantity (short tons)	1915 Value	1916 Quantity (short tons)	1916 Value
Secondary copper, including that in alloys other than brass	99,937	$33,498,882	140,000	$68,880,000
Remelted brass	137,500	40,788,000	300,000	127,440,000
Secondary lead	36,400	7,416,600	56,700	13,289,400
Recovered lead in alloys	42,500		39,600	
Secondary spelter	52,900	14,433,600	50,700	14,284,400
Recovered zinc in alloys other than brass	5,300		2,600	
Secondary tin	5,250	10,554,180	7,600	15,131,040
Recovered tin in alloys	8,400		9,800	
Secondary antimony	2	1,811,568	80	2,270,016
Recovered antimony in alloys	3,100		4,400	
Secondary aluminum	5,700	5,802,100	12,900	23,430,200
Recovered aluminum in alloys	2,800		6,400	
Secondary nickel			16	652,800
Recovered nickel in alloys			800	
		114,304,930		265,377,856

Recovery of Lead

The secondary lead recovered in 1916 amounted to 93,300 tons, or about 17,400 tons more than the previous year. A large portion of the recovered lead in alloys was derived from old babbitt, solder, type metals and white metal drosses. The main sources of secondary pig lead are old pipe, lead cable, battery lead and lead lining of acid tanks. Smelters reported the recovery of 14,694 tons of lead from scrap lead and scrap antimonial lead. The total output of secondary lead was equal to

16.8 per cent of the refined primary lead produced in the United States in 1916, compared with 14.3 per cent in 1915.

The output of secondary zinc, including that in brass, amounted to 115,000 tons and equaled 16 per cent of the production of primary spelter in the United States in 1916, compared with 19 per cent in 1915. The recovery was about 22,500 tons more than in 1915, this increase having been due to the added quantity of zinc recovered in brass. The production of spelter from drosses and skimmings made by zinc smelters, that do not treat ore, was 2800 tons less in 1916 than in the previous year. This was due partly to the redistillation of the low grades of spelter to meet the demands for spelter suitable for brass used in making war munitions. The principal reason, however, was that there was a decrease of about 97,000 tons in the quantity of galvanized sheets, pipes and other forms produced and, therefore, less zinc dross was shipped by galvanizing plants.

The zinc recovered in alloys other than brass amounted to 26,000 tons, compared with 5300 tons in 1915. Of the 50,700 tons of secondary zinc recovered as spelter, 29,663 tons were obtained by redistillation from drosses and skimmings and from scrap zinc treated by the electrolytic process. The exports of zinc drosses which totaled 3668 tons in 1915, decreased to 48 tons in 1916.

The production of secondary antimony of which all but 80 tons were recovered in alloys, increased from 3102 short tons in 1915, to 4480 tons in 1916. The principal materials refined or remelted which contained antimony as an alloy were hard lead drosses, babbitt, solder, pewter and type metal.

The secondary tin recovered in 1916 was equal to about 24 per cent of the tin imported as metal or as oxide, and amounted to 69,055 short tons. This recovery increased from 13,650 tons, valued at $10,554,180 in 1915, to 17,400 tons valued at $15,131,040 in 1916. Nearly all clean tin plate scrap is detinned by one of the following three electrical processes: Electrolytic alkali, chlorine and alkali saltpeter. The largest recoveries of tin were made from the scruff and drosses resulting from the coating of tin plate and terne plate and amounted to more than 4850 tons. The quantity of tin plate made in 1916 was about 200,000 tons more than the previous year and the quantity of tin recovered from scruff and drosses increased more than 1000 tons. About 2600 tons of tin were recovered from clean scrap tin plate, either as pig tin, tin chloride or tin oxide. Apparently only about 750 tons of pig tin were recovered from scrap tin clippings, old tin pipe and tinfoil.

Only one plant reported using solely old tin containers from which the tin coating and solder were first sweated and the black plate was then remelted to make sash weights. An increased quantity of tin was recovered in bronze and a considerable part of the brass remelted contained a small quantity of tin and lead. Other alloys from which secondary tin was recovered were solder, babbitt, pewter, terne metal and electrotype metal.

The recovery of secondary aluminum in 1916 amounted to 19,300 tons valued at $23,430,200, as compared with 8500 tons valued at $5,802,100, in 1915. The quantity recovered in alloys totaled 6400 tons. The increase in quantity of secondary aluminum in 1916 partly was due to the growing practice of utilizing aluminum castings in automobile construction. Also the high prices which prevailed no doubt resulted in considerable aluminum wire being remelted. Aluminum chips from castings used in the manufacture of automobiles have become a large source of secondary aluminum. By the old methods of treatment the loss in remelting such chips sometimes was as high as 40 per cent, but according to experiments made by H. W. Gillett and G. N. James, reported by the bureau of mines, bulletin No. 108, 1916, such losses can be reduced to as low as 10 per cent.

In 1916 the first effort was made to ascertain the quantity of secondary nickel recovered as nickel or in alloys. The reports received showed that 816 tons of nickel were recovered, a considerable part of which was from clean, new scrap. This does not include nickel in scrap ferrous alloys, nor the recoveries from secondary sources made by the International Nickel Co. No direct production of nickel from American nickel ores is known to have been made in the United States in recent years, but an equivalent of 918 short tons of nickel were saved in 1916 as a by-product in the electrolytic refining of copper. Nearly all of the secondary nickel recovered in 1916 was obtained from old nickel anodes, german silver and monel metal. The accompanying table gives the quantity and value of secondary metals recovered in the United States in 1915 and 1916.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Preventing Blow-Holes in Yellow Brass

We have experienced considerable trouble in making yellow brass castings from the following composition: Copper, 63 per cent; zinc, 34 per cent; lead, 2.5 per cent, and tin, 0.5 per cent. The zinc is added after the copper is melted and the bath is covered with charcoal, which is skimmed off before pouring. Notwithstanding this precaution, the castings contain blowholes and particles of charcoal also are occluded.

Charcoal is used in connection with the melting of copper and its alloys because of its reducing action on the oxide of copper. This oxide forms on the surface of the metal after it is melted and would be absorbed by the copper if charcoal were not used. The charcoal also combines with the oxygen in the atmosphere in the crucible, and by eliminating the oxygen, protects the metal from the gas. Charcoal, therefore, prevents blowholes in castings and this statement may be verified easily by making experiments without the use of this material. However, in some instances, it is not advisable to employ charcoal. Therefore, another material must be substituted for it and common bottle glass, with crushed anthracite coal, will be found to be satisfactory. Also, a small amount of salt should be added with the cold charge of copper. The glass and coal also should be used, the purpose being to provide a slag that will melt with the copper and will cover it to exclude the air and to prevent gas absorption.

A yellow brass, high in zinc and lead, is a difficult alloy to cast successfully in sand. The mold should be well-vented and secured and the lip of the pot should be held close to the sprue head. Furthermore, all dirt should be skimmed back to expose the clean metal and then the crucible should be tilted to fill the

head almost instantly. Furthermore, the sprue head should be kept full of metal until the mold has been poured. An alloy consisting of 95 per cent zinc and 5 per cent aluminum should be used as a deoxidizer in the proportion of 0.5 per cent to the charge and if no difference in the castings is noted, an increase of 4 ounces in this deoxidizer should be made and this should be continued until a good casting mixture is obtained.

Overcoming Porosity in Aluminum Castings

Porous aluminum has caused us considerable trouble during the past few months and we would like to know how this may be avoided. We have tried chilling parts of the casting, which seems to eliminate this trouble at times, but it always reappears. We have tried different temperatures from 1100 *to* 1400 *degrees Fahr. without satisfactory results. What do you consider the proper temperature at which aluminum crank cases should be cast with wall thicknesses varying from* 3/16 *to* 3/8 *inch? We are using the standard No.* 12 *aluminum alloy.*

The difficulty outlined is a serious one to manufacturers of aluminum castings since its origin is unlike that which produces porosity in copper and brass castings and, consequently, it cannot be remedied by the use of deoxidizers. The trouble is caused by the aeration of the aluminum by hydrogen which is generated by the aluminum as a result of the decomposition of the moisture that exists in the sand of the molds. Also, the temperature of the aluminum when poured has an important bearing on the problem. When the metal is at a red heat it is exceedingly active chemically and even if the temperature of the casting is a little lower than that necessary to decompose steam, the affinity of the aluminum for oxygen may easily bring about this reaction. The result is that aluminum is formed and in badly aerated castings it can be seen with a magnifying glass in the form of a white or grayish powder existing between the grains of the aluminum. The liberated hydrogen is diffused throughout the mass of aluminum in minute globules where they appear to be held owing to the viscosity of the fluid metal and its low specific gravity. The hydrogen is held in the same way as carbonic acid in water and probably the pressure to which the metal is subjected by the head of metal in the sprue materially aids in retaining the gas. In this connection it should be pointed out that solid blocks of aluminum, 4 inches square and cast in open molds, exhibited the same degree of porosity at the top of the cast as at the bottom.

The addition of such elements as magnesium, calcium, etc., only aggravates the conditions as they increase the chemical activity of the aluminum. The addition of sulphur, selenium or tellurium to the aluminum is helpful in some measure although by no means to the same extent as the addition of phosphorus, manganese, etc., to bronze and brass. Arsenic and antimony are worthless for aluminum additions, and notwithstanding many investigations and experiments to secure a remedy, it seems that nothing can be depended upon to corsect the porosity of aluminum castings. Preventive measures only may be resorted to and, of course, it is unnecessary to state that aluminum should not be overheated during melting, because its chemical activity increases with a rise in temperature. At high temperatures, aluminum will reduce silicon from the silica contained in the crucible and this causes the black particles often found in castings.

Moisture Causes Trouble

While overheating is not the direct cause of porous castings, nevertheless, it may have a contributing effect. The greatest danger arises from the moisture in the molding sand and, therefore, the use of chills, provided they are not allowed to sweat in the mold before the metal is poured, is helpful in getting sound castings. A free venting sand that will bond with a minimum of moisture should be selected and the molds for large castings should be vented. In making the molds every effort should be exercised to provide an outlet for the steam from the aluminum by facilitating its escape to the atmosphere. With the first contact of hot metal and moist sand, a dry crust is formed on the sand next to the aluminum which protects the metal from the action of the steam until it solidifies, providing the steam is not forced back by the impenetrable nature of the sand backing this crust. When this occurs, the aluminum in contact with the sand will tremble, as can be noted from the movement of the sprues. A temperature of 1400 degrees Fahr. is not too high to insure the running of thin castings and sections ¾ inch thick have been poured at 1382 degrees Fahr.

Overcoming the Cracking of Match-Plates

The aluminum match-plates we are making crack immediately after pouring. Kindly recommend an aluminum alloy containing zinc and copper suitable for this work.

A satisfactory aluminum alloy follows: Aluminum, 82 per cent; zinc, 15 per cent, and copper, 3 per cent. When making the alloy, the copper should be melted in a crucible under, charcoal and when molten, an equal quantity of aluminum should be added gradually and the mixture stirred thoroughly while the addition is being made. Six pounds of this alloy then are melted with 79 pounds of aluminum and 15 pounds of zinc to produce the desired mixture. Also, the copper may be added to the aluminum by melting a portion of the latter, raising it to a red heat and introducing the copper in thin sheets. If the plates continue to crack when this alloy is used, omit the zinc entirely and substitute an alloy containing 92 per cent aluminum and 8 per cent copper.

Casting Aluminum in Plaster Molds

We have been advised that aluminum castings are being made successfully in plaster of paris molds by some secret method of treating the plaster.

Since iron, bronze, silver and other metals can be successfully cast in plaster of paris molds, there is no reason why aluminum castings cannot also be made in this way. If a pattern contains many undercuts, it may be advisable to mold it in plaster, but the process will be too expensive for castings that can be molded successfully in sand. The plaster is mixed with pulverized asbestos, fine anthracite ashes or pulverized common brick to reduce its tendency to shrink and crack when heated. This material can be mixed in the proportions of one to two of three parts, the third being plaster. The plaster and refractory substances are mixed with water to a creamy consistency and this is cast around the pattern to form a mold which may or may not be split according to the shape of the pattern. When the latter is intricate, as in the case of a statuette, it is not always possible to split the mold, and the pattern frequently is made of wax which is molded or cast over the core that makes the casting hollow and thereby economizes in the amount of metal used. When the mold is finished, it is carefully dried and then heated to melt out the wax which flows through openings previously provided. According to a process recently patented, the wax is melted out of the mold by heating the latter in hot water, which it is claimed prevents the wax from penetrating the mold when it is melted out. If the wax soaks into the mold, it must be burned out before the metal can be poured. In any event, it is necessary to raise the mold to red heat to drive out all the moisture, as the water is held firmly by the plaster and

cannot be driven off at the boiling temperature.

After being heated to redness, the mold is soft and, therefore, it is advisable to bed wires and nails in the plaster to strengthen the mold in the same manner as a complicated core would be strengthened. After being heated to redness and held at this temperature a sufficient time to insure heating it throughout, the mold must be imbedded in sand to hold it together while the metal is being poured. By one process the mold is soaked in lard or some other oily substance which, it is claimed, prevents blowing if any moisture should be left in the mold. It is of the utmost importance that all of the moisture be driven out of the plaster mold, as otherwise the metal, when poured, will scatter, or if only a small amount of moisture is present, it will fail to lie on the surface of the mold and a hole will result.

In view of the intricate nature of this process, it would seem inadvisable to pour aluminum into a mold of this kind when bronze could be used just as advantageously and, therefore, we doubt the report that aluminum is being cast into plaster of paris molds since nothing will be gained thereby. However, aluminum is being cast successfully in dies or permanent molds, although we do not recommend an attempt at die-casting before a thorough study has been made of the process.

Making Street Railway Journal Brasses

Kindly give us some information regarding bronze mixtures for street railway journal brasses. We have used the following:

Copper, 84.75 per cent; zinc, 13 per cent; phosphor copper, 0.25 per cent and babbitt metal, 2 per cent. The latter contains 93 per cent tin; 3 per cent copper; 3 per cent antimony and 1 per cent nickel.

For liners we use a mixture of 40 per cent babbitt metal and 60 per cent lead. Could you suggest any better method for lining these brasses?

So far as we can ascertain there is no standard mixture for street railway journal brasses. A large percentage of these castings are made from scrap metals exclusively. The best alloys for this purpose are those containing high lead of which the one known as *plastic bronze* is the best illustration. This alloy contains approximately 30 per cent lead; 5 per cent tin and 65 per cent copper.

For your work we suggest the use of the following alloy: Copper, 78 per cent; tin, 7 per cent and lead, 15 per cent. The bearings should be bored, tinned and then lined with the following alloy: Lead, 80 per cent, and antimony, 20 per cent. Instead of making the alloy to this formula, what is known as an antimonial lead should be purchased and the bearings should be lined with this alloy.

The formula for the babbitt metal should be changed to the following: Tin, 89.50 per cent; copper, 3.50 per cent; antimony, 7 per cent, but no nickel addition should be made.

Applying a Clay Wash to Crucibles

We are melting bronze in a natural draft crucible furnace, using anthracite coal for fuel. Some of the crucibles have a life of only 12 heats while others average as high as 22 heats. Kindly let us know whether it would be advantageous to daub the pots with a mixture of fire clay and water. How should this be applied and also let us know whether it will injure the crucibles?

Some substance should be mixed with the fire clay that will reduce the shrinkage, otherwise, when dry, it will flake off and alligator cracks will form. A satisfactory substance to use for this purpose is carborundum fines, about 70 per cent of the latter and 30 per cent of fire clay. This should be mixed with water containing approximately 5 per cent of silicate of soda or water glass. This mixture should not be applied to new crucibles as they will absorb moisture and will flake or spall. When two or three heats have been made in the crucibles and after cleaning the outside thoroughly, paint them with this mixture and let it dry slowly before using the pots again. The inside of the crucible should be kept clean of slag and adhering metal and may be painted occasionally to keep it clean. Only a thin coating should be applied and the pots should be cold when it is brushed on. The mixture should be dry before the crucibles are used again.

Casting Bronze Sleeves Onto Steel Shafts

We would like to have you suggest a mixture suitable for sleeves to be cast onto steel shafts and also a method for doing this work. Recently we cast sleeves, 43 inches long and ¾-inch thick, onto two plungers, but they cracked and were condemned. What is the best method of mixing new and old metals? For example, a 300-pound heat of bearing metal may consist of one-third new metal and two-thirds gates, risers, scrap, etc. The mixture is to consist of copper, 7 per cent; tin, 12 per cent, and lead, 11 per cent. Should the copper be melted first, followed by the additions of tin and lead and last the scrap, or should the scrap be added when the copper is melted, to be followed by the tin and lead?

The following mixtures will prove to be satisfactory for sleeves: Copper, 89.50 per cent; tin, 6.50 per cent; zinc, 2.50 per cent, and lead, 1.50 per cent. The cracking of the sleeves probably is due to the fact that the plungers were not sufficiently heated before the bronze was cast. The shell should be heated to a dull red so that it will contract as the bronze shrinks. It is advisable, when casting bronze sleeves on steel, to flow off considerable metal, thereby heating the steel and causing the bronze to adhere. This practice also prevents cracking. The bronze should be poured very hot, as otherwise it will chill and will not flow out of the riser.

When old and new metals are melted together and if the copper is melted first, it is more economical to add the mixture after the copper is molten as it then will be converted into bronze with a lower melting point than the copper and the metal is less liable to chill when the addition of the scrap is made. However, as a rule, it is advisable to melt the scrap and copper together and if crucibles are used, a pot with the bottom cut off should be placed on top of the melting crucible. This will permit of placing the entire charge in the upper and lower crucibles. When scrap and copper are melted together, the scrap melts first and flows over the copper with the result that the charge melts more rapidly than otherwise. After the high-melting temperature metals are melted, the white metals are added.

Mixtures for Globe Valves

We would like to obtain several mixtures for globe valves.

Where quality is of more importance than cost, the following alloy may be employed: Copper, 90 per cent; tin, 8 per cent, and zinc, 2 per cent. The high cost of valves made from this mixture is due largely to the difficulty of machining the metal. The following alloy will produce satisfactory valve bodies and is easily machined: Copper, 87 per cent; tin, 7 per cent; zinc, 3 per cent, and lead, 3 per cent.

A cheaper mixture than either of the foregoing contains copper, 86 per cent; tin, 5 per cent; zinc, 5 per cent, and lead, 4 per cent.

The best metal should be used for the valve bodies and hub, but for the other parts of the valve scrap may be employed. The stem, however, should not be too heavily leaded.

Departmental Co-operation Effects Economies

Frequent Conferences Between the Heads of the Drafting Room, Pattern Shop and Foundry Will Expedite Operation at Reduced Costs

By J Shaw

HARMONIOUS relations between the various departments of any works are a valuable asset and the question of design is intimately connected with the problems of the foundry. Therefore, I feel that the drawing office must be included, since few draftsmen appreciate the many difficulties the foundryman has to contend with. It is essential that the designer keep in mind the cooling processes through which the casting must pass and the effect which will be produced upon any member if it is cooled faster or slower than other parts of the casting. I believe many castings are in service that are of doubtful reliability owing to internal strains and lack of harmony in their constructive elements. The usual drawing office assumption that sections of castings are to be regarded as beams in tension or compression, as the case may be, and their strengths calculated accordingly, takes no note of the casting passing from the molten to the cold state and ignores the stresses set up by unequal contractions so that some members, that were expected to be in tension, are actually in compression and *vice versa*.

Suggestions for Designers

There are three points to which I would like to direct the attention of designers:

First.—Faulty design, which may be subdivided into designs that cause undue stresses through cooling strains and others that cause unsound places in important points through excess metal.

Second.—To save joints, designers ask for castings that are both expensive and hazardous to make, the probable losses being out of all proportion to the economies to be effected.

Third.—Simplicity of design from the molding standpoint and needless alteration of design in small details that causes new tackle to be made and adds to the cost of production.

Discussing these suggestions in the order given, I know it is not always possible to avoid quick changes from thin to thick sections and it is here that the knowledge and experience of the foundryman must come to the rescue. But while it is possible to meet these conditions by various expedients, engineering design is at its best when its shapes are at once suitable for their intended purpose, and easily and cheaply produced.

A baffle plate recently made was 3 feet in diameter and the outer edge was 4 x 1-inch, while the perforated portion was ½ inch thick; several of these failed in the machine shop, though the difficulty was overcome by running the center and bearing the outer edge from top to bottom. In this case there was no reason why the middle of the plate should not have been thicker, thereby overcoming the cooling strains. Another instance is referred to, to illustrate strains that do not develop immediately. A large disc crank was cast and after a few days was shipped. It arrived minus a section weighing nearly two tons which was found along the road. The internal strains were so great that the piece jumped clear of the freight car. That design is responsible for many leaky and porous castings is well known and the use of large fillets and brackets are often a source of weakness rather than strength.

Wherever there is a thick section, that portion of metal will be the last to set and will act as a feeder to the other parts, leaving a void or at least a spongy place that designers do not always overcome. Frequently, a slight modification in design will alter this. We made a number of 8-inch pipe bends which evidently were fitted to 10-inch pipes at one end. The diameter of the flange merely was increased and a large fillet was put in nearly to the edge of the bolt hole. There is little doubt that the metal was not solid here and it was only after rusting the castings that they passed the water test.

We experienced trouble with the cylinder of a plunger pump in which two plungers work in opposite ends of the barrel, with a partition cast in the center. This thick partition caused a porous place which the acid water from the mine quickly cut away, causing the cylinder to be renewed every few weeks. Making the partition thinner and strengthening the thin ribs eliminated the trouble.

In considering the second suggestion, it undoubtedly is true that there are advantages in having as few joints in a machine as possible to lessen fitting costs and also to reduce the risks from vibration, etc., but often the added cost and risk in the foundry is out of all proportion to the advantages gained. Recently a set of steel pipes was sent to us from a firm that was urgently in need of them for munition work. Some of the bends were about 8 feet long and 4 feet on the other leg, and only 10 inches in diameter. Several of the remaining pipes had long double bends costing about £5 per ton for patterns alone. These were long enough to cut in two, making two ordinary angle bends. As quick delivery could not be promised on the pipes as received, the whole set was altered in the location of joints, thus proving that there was no real reason for these extreme cases.

I know that the drafting staff often is compelled to make slight alterations to meet the views of the consulting engineer, but if both realized to cite a recent example, that alterating the position of the feet and slightly increasing the size of a condenser increased the molding cost £1 per ton in tackle alone, the question would receive more consideration.

Deathknell to Maximum Production

There are two executive heads in every foundry who should work together, namely the foreman patternmaker and the foreman molder. It is quite natural for the patternmaker to make a pattern in such a way as to reflect credit on himself or to save money for the department he supervises. This being the case, he is liable to do things contrary to the wishes of the molder. This friction is the deathknell to maximum production. The chief consideration should be, how can the pattern be made to produce the casting at the least cost? Other considerations should be length of service, prevention of warping, economy of production and accuracy of castings. The pattern shop is operated for the final production of castings and this work is a part of the cost, the same as that of pig iron; therefore, if a mahogany pattern that is so nice that it would do for a parlor ornament will serve best, make it and don't spare expense.

From the presidential address delivered before the Birmingham (Eng.) branch of the British Foundrymen's association.

High Sulphur is Not So Bad as it is Painted

The Supposed Arch Enemy of the Foundryman is Presented in Another Role by a Gray Iron Man Who Knows

By T Mauland

SULPHUR is considered cast iron's worst enemy, and many of the troubles of the foundry are laid to it whenever it happens to be high. Authorities say that sulphur combines carbon, increases hardness, shrinkage and chill; reduces strength; causes dirty iron, blow-holes and shrinkage cracks and makes iron congeal quickly. Generally, this is true, but my experience has been that sulphur, within certain limits, increases strength in soft iron. For agricultural or similar classes of castings, specifications have called for a maximum sulphur of 0.08 or 0.09 per cent. The American Society for Testing Materials, I understand, is considering increasing this limit to 0.10 per cent.

Relation of Sulphur to Hardness

In castings of this class, sulphur is generally used as an indication of the hardness. I have noticed, however, that castings with a higher sulphur, up to 0.12 per cent, will sometimes be good, strong and soft, while at other times, with the other elements the same, the castings will be hard with sulphur less than 0.09 per cent. It has been my experience that when using a mixture of 55 per cent pig, 35 per cent home scrap and 10 per cent No. 1 cast scrap, and it became desirable on account of economy to substitute 0.12 to 0.15 per cent sulphur off-grade pig iron for the No. 1 cast scrap, I could use a mixture of 45 per cent pig iron, 35 per cent home scrap and 20 per cent off-grade pig. In other words, I would use 20 per cent off-grade pig in place of 10 per cent No. 1 cast scrap, although the average sulphur analysis of the scrap would be better than the off-grade pig. The analysis of the castings from the off-grade pig mixture would be the same, except that it would show a higher sulphur. But the iron would be just as good and just as soft as the lower sulphur iron made from the scrap mixture.

In steel, sulphur has had the same bad reputation that it has in the foundry. Bessemer steel specifications generally call for 0.08 per cent or less, and open-hearth specifications for 0.05 per cent or less, as the maximum sulphur limit. Dr. J. S. Unger, of the United States Steel Corp., has made some extensixe tests with high sulphur in open-hearth steel. These tests which were made with varying sulphur contents from 0.03 to 0.25 per cent, showed that good steel could be made with the higher sulphur. High-sulphur steel was made into rivets, chain, sheets, wire, tubes, pipes, forgings, wire rope, rails, etc. These tests showed that high-sulphur steel could be made with mechanical and working properties equal to that of low-sulphur steel.

Dr. J. E. Stead, the eminent English metallurgist, in a paper before the British Iron and Steel institute, cites experiments with steel containing from 0.10 to 0.50 per cent sulphur with as good or superior mechanical properties, as steel of lower sulphur. The following extracts are taken from his paper:

> It was proved long ago that manganese counteracted the effect of sulphur, but books have been written in which sulphur was condemned, and engineers and their experts read those books and copied them, so that even to this day steel rails, etc., of exceptional quality are rejected because the sulphur exceeds arbitrary limits, even when all mechanical tests proved that material is perfect. Steel high in sulphur resembles wrought iron and is more or less fibrous. It is a fact that steel called free-cutting fibrous steel is used today and the peculiar properties referred to are due to the deliberate introduction of sulphur into the steel. Such material contains about 0.15 per cent sulphur. Sulphur, then, may be regarded as a friend when it is used intelligently and is not invariably the enemy it is represented to be.

Within the last few months I have experienced some rather extraordinary cases of high sulphur iron showing up very soft. The casting used as a test piece was a small gray iron box or bushing, 2½ inches long with a ¾-inch core. The lighter portion, including the upper end, is 3/16-inch thick. The heavier portion is ¼-inch thick. The ¾-inch cored hole is reamed to a 0.890-inch hole on a gang drill. This machining is done with a feed of 4¼ inches per minute. This casting is one that is liable to cause trouble in machining on account of a hard upper edge in the lighter section. Ordinarily it is not safe to run this iron over 0.10 per cent in sulphur, and this casting has given trouble with sulphur as low as 0.08 per cent. In the cases just mentioned where the iron was satisfactorily soft, the analyses were as follows:

Lot No.	Sulphur, per cent	Silicon, per cent	Manganese, per cent	Phosphorus, per cent	Total carbon, per cent
1	0.156	2.11	0.44	0.70	3.39
2	0.143	2.12	0.44	0.70	3.47
3	0.145	1.93	0.46	0.40	....
4	0.170	2.09	0.44	0.40	....

The casting, the small box previously referred to, machined soft from all of the four lots.

The high sulphur in lots Nos. 1 and 2 was obtained accidentally. I had already tested the castings for softness, and was very much surprised that analysis showed such high sulphur. The high sulphur in lots Nos. 3 and 4 was obtained by using high-sulphur pig and adding sulphur to the molten metal.

Not So Bad as Painted

The cases of good iron with high sulphur and many cases of poor iron of practically the same analysis but lower sulphur, lead me to believe that sulphur in itself is not nearly so bad as it has been painted. Where sulphur is blamed for poor iron, I do not say that this iron would not have been better had it been lower in sulphur, but I believe that in most cases iron higher in sulphur could be made that would give satisfactory castings.

At this time I will not try to explain why some high sulphur iron makes very good castings, but I am inclined to believe that oxygen, as described in papers written by J. E. Johnson Jr., one of which was read before this association several years ago, has much to do with it. The oxygen in the four lots cited above was very low, but I have not had the opportunity to do enough work along this line to draw definite conclusions.

Presented at the Boston meeting of the American Foundrymen's association.

Linthicum Bronze Foundry Organized

The F. H. Linthicum Bronze Foundry, Baltimore, recently organized, will specialize in the manufacture of small duplicate castings with facilities

for production in large quantities and a capacity for castings up to 500 pounds each. F. H. Linthicum, the proprietor of this plant, was sales manager for the American Manganese Bronze Co., Philadelphia, during the past two years and for seven years previous held positions as superintendent and assistant manager of several large shops. W. C. Lilly, superintendent of Mr. Linthicum's foundry, occupied a position in a similar capacity with the Nelson Valve Co. for six years and more recently was superintendent of the American Manganese Bronze Co., Philadelphia.

Advantages of the Round Bottom Plane

By M. E. Duggan

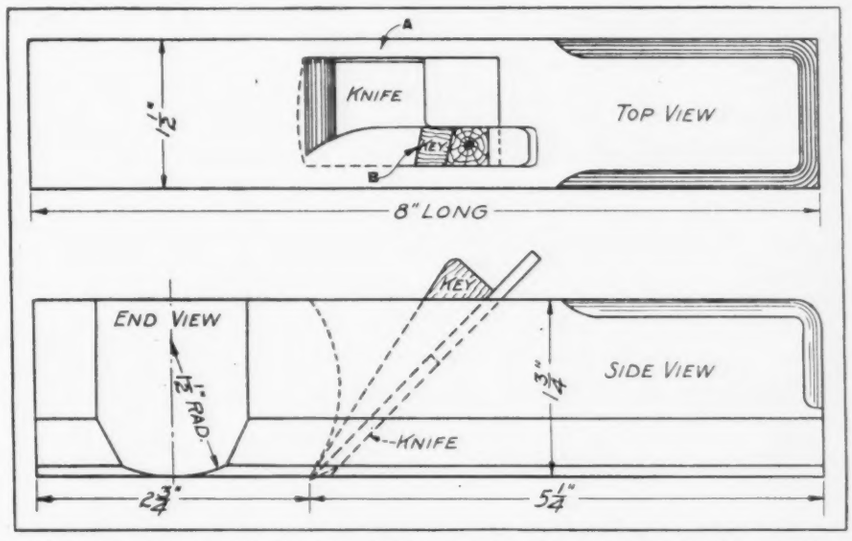
A round bottom plane is a handy tool in the pattern shop, provided it is neither a toy nor a nuisance because of the way it is made. Some of these planes either are too large or too small, or they contain so many parts that considerable time is required to assemble and adjust them. I have designed a set of round bottom planes which have given satisfaction, and the best evidence of their utility is the fact that they are borrowed and used by every patternmaker, carpenter, and millwright in the shop where I am employed.

These planes are made from stock planes, obtainable in any hardware store. Also, any plane in use may be changed to my design. However, if it is necessary to purchase new planes, before doing so, strike circles on a piece of paper and select the planes that may be shaped to these arcs. A narrow plane may be purchased for a small radius and a wide plane for a large radius.

For the 1½-inch radius I selected a plane with a 1-inch bit, which was closed after it was cut down. The open side of the plane was closed by gluing a piece of maple the full length of the plane, as shown at *A* in the accompanying illustration. The key projects above the top, and the knife, about ¾ inch. I also have made another improvement in this style of plane which should receive consideration by manufacturers of these tools. As a rule, the wood key or wedge of the ordinary stock plane is never where it belongs, that is, close to the side of the plane to prevent shavings from working into this space and clogging the throat of the tool. I taper the front of the wedge to fit a corresponding taper in the body of the plane. This wedge cannot fall out or shift by hammering on the plane when the knife is being set. As a matter of fact, the harder it is driven, the tighter it locks the knife and hugs the side of the tool. The bottom end of the wedge is tapered to increase the opening in the throat. I have eight round bottom planes which take up little space and are not burdensome to carry.

Activities of a Large Engineering and Construction Company

Before the United States entered the war, Westinghouse, Church, Kerr & Co., New York, were prominently connected with important work for the industries of the country to make it possible for them to meet the demands of the war. Among the plants built are included an arsenal with an extension to another, a small arms plant, a complete powder works, two shell-loading plants, airplane motor plant, nitrogen fixation and sulphur mining plants. During the past five years continuous work has been done for the Winchester Repeating Arms Co., which includes a total of 54 separate agreements and 53 repeat orders, involving engineering and construction work of almost every variety.



TOP AND SIDE VIEWS OF AN IMPROVED TYPE OF ROUND BOTTOM PLANE

Foreign Trade Council Postpones Meeting

The annual convention of the National Foreign Trade Council, which was to have been held at Cincinnati, Feb. 7 to 9, has been postponed to April 18 to 20. This change in dates was made owing to the railroad congestion and the desire of the council to co-operate with the government in the relief of this situation.

Grimes Molding Machine Co. Increases Facilities

The firm name of the Midland Machine Co., Detroit, manufacturer of molding machines and foundry equipment, has been changed to the Grimes Molding Machine Co., to more closely identify this concern with the name of the machine which it builds. Manufacturing operations now are being carried on in a new plant recently completed that provides double the facilities of the former works and the output will be increased threefold.

After an existence of nine years as a department of the Chicago Pneumatic Tool Co., the motor truck interests of that concern have been taken over by a new organization, known as the Little Giant Truck Co. Its officers are the same as those of the parent company, and include W. O. Duntley as president; W. B. Seelig, secretary; L. Beardsley, treasurer, and T. J. Hudson, sales manager. The headquarters of the Truck Co. are in the Little Giant building, 1615 Michigan avenue, Chicago.

The firm name of the Lavigne Mfg. Co., Detroit, producer of brass castings, has been changed to the Commonwealth Brass Corp. The officers of the company continue as follows: President, P. D. Dwight; vice president and general manager, N. A. Henwood; secretary and treasurer, Carl L. Brumme, and superintendent, C. S. Kellum.

The Nagle Corliss Engine Works, Erie, Pa., builders of air compressors, vacuum pumps and engines, have established an office in the Bourse building, Philadelphia.

The firm name of the Osborn Mfg. Co., Cleveland, manufacturer of molding machines, foundry equipment and supplies, has been changed to the Cleveland-Osborn Mfg. Co.

THE FOUNDRY

A monthly journal devoted to all branches of the foundry trade

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Semi-Steel Projectiles

FOR several years Germany and France have been using thousands of semisteel projectiles, and in spite of the rigid specifications that have to be met, the foundrymen of these countries have overcome all obstacles and are producing a metal that tests as high as 40,000 pounds per square inch. It is true that from 40 to 50 per cent steel is used in these mixtures, but this practice is not uncommon in this country and many foundrymen undoubtedly could meet the requirements of the ordnance department if called upon to do so. Considerable interest now is being manifested in semisteel in Washington, and some of our foundrymen have been invited to discuss the possibilities of the use of this metal in the production of projectiles. Semisteel shells have been used by the navy for practice purposes and six months ago the attention of ordnance experts in the war department was directed to the activities of France and Germany in this direction. If the foundries of this country are invited to produce semisteel of a density and strength to meet the needs of shell work, it is certain that they will rise to the occasion and the output of projectiles will be increased in quantities that will be amazing.

Piecework—A War Measure

FIGURES for 1917 covering the earnings of molders, molding machine operators, cleaners and other piecework employes, that are being compiled by foundrymen for the information of income tax collectors, reveal surprising totals. In some plants machine operators have received nearly $5000 in wages, and $2500 and $3000 for the year's efforts are commonplace figures that were attained last year by thousands of workers in casting plants. Few crafts are paid so well and not many vocations hold out the inducement for maximum effort and application as that offered by foundry employment on a piecework basis. It is an unwritten law in piecework shops that when a price once is set it is never changed, and in appreciation of this, records of production are made and broken by new high marks that never were believed to be possible of accomplishment. Nor have these increased wages been without compensation for the employer. Production is increased without unnecessary addition to the equipment, thereby reducing the overhead and other fixed expenses. Furthermore, this has relieved the labor situation in many of these shops, and the reputation for high wages is an attraction for the employes of other plants that impels their gravitation to these foundries. The introduction of piecework in the patternshop, always considered impossible of achievement, has been tried out successfully in one large plant. Not only are the patternmakers earning from $40 to $110 per week, but the number of employes has been reduced from an average of 90-odd to less than 50. The setting of prices for patterns is more difficult than for castings, and the employment of a skilled man for this work is essential. Wherever a fair rate has been set for cleaning and chipping castings, the earnings of the workers have been doubled and trebled and the output of the plant has been increased proportionately. Piecework as a war measure certainly has speeded-up production and increased output.

Personal

T. S. Disler has been appointed traffic manager of the Fort Pitt Steel Casting Co., McKeesport, Pa.

C. P. Coleman has been elected president of the Worthington Pump & Machinery Corp., 115 Broadway, New York.

D. G. McIntyre has been appointed general manager of the Skagit Steel & Iron Works, Sedro-Woolley, Wash., succeeding F. R. Faller, resigned.

F. Frith Pickslay, formerly of New York, has been made sales manager of the Farrell-Cheek Steel Foundry Co., Sandusky, O.

Walter F. Kaine has been elected president of the T. P. Kelly & Co., New York, manufacturers of foundry facings and supplies, to succeed the late Michael F. Kerby.

George F. Fileshifter, formerly affiliated with the American Foundry Co., Indianapolis, has been appointed superintendent of the Hoosier Castings Co., Connersville, Ind.

A. R. Vanderford, formerly affiliated with the Cumberland Foundry & Machine Co., Nashville, Tenn., has been appointed superintendent of the foundry operated by the Youngstown Sheet & Tube Co., Youngstown, O.

D. C. Durland, formerly executive head of the Sprague Electric Works of the General Electric Co., New York, has resigned to accept the presidency of the Mitchell Motors Co.

F. H. Bird, formerly traveling engineer for the American Steel Foundries, Chicago, has received a first lieutenant's commission in the ordnance department of the United States army.

W. H. Harman, vice president and general sales manager of the Southwark Foundry & Machine Co., Philadelphia, has been appointed president of the company, succeeding Robert Radford, who has been made chairman of the board of directors.

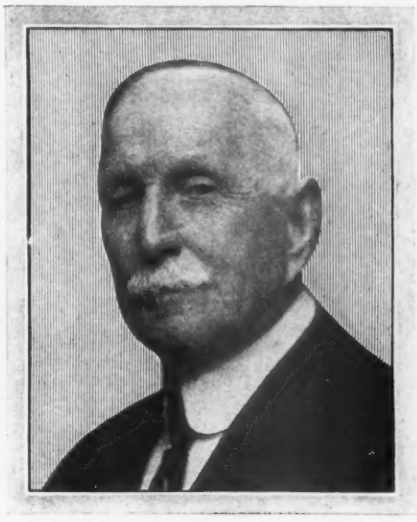
E. F. Lake, metallurgical engineer, Detroit, has been appointed assistant superintendent of the Rich Tool Co., Chicago, manufacturer of valves for airplane and gas engines, stainless steel, etc.

George Kershaw, formerly works manager of the J. I. Case Threshing Machine Co., Racine, Wis., and of the Advance-Rumely Co., La Porte, Ind., resigned the latter position Jan. 1 to become works manager of the Standard Aeroplane Co., Elizabeth, N. J.

H. S. Gulick has resigned as metallurgical engineer for the More-Jones Brass & Metal Co., St. Louis, to accept a position as assistant superintendent of the Duquesne Steel Foundry Co., Coraopolis, Pa. Mr. Gulick is vice president of the American Institute of Metals.

Robert Mackenzie, formerly pattern shop foreman of the Swedish Crucible Steel Co., Detroit, has been appointed assistant general manager of this company which contemplates installing an electric furnace and thereafter will make steel by this process as well as by the crucible and converter methods.

Charles S. Humphrey, president of the Humphrey Pipe & Foundry Co., Bellefontaine, O., has disposed of his interest and now is equipping a brass and aluminum foundry in the same city which will be provided with a nickelplating department. The firm will be known as the Humphrey Bronze & Aluminum Co.



C. W. LEVALLEY

Frank W. Hall has been appointed commercial manager of the Sprague Electric Works of the General Electric Co., New York. With the exception of a short period, Mr. Hall has been connected with the Sprague Works continuously for 22 years in various engineering and sales capacities and prior to his present appointment he occupied the position of sales manager.

W. D. Berry, for a period of more than five years general superintendent of the Keystone Bronze Co., Pittsburgh, with headquarters at New Brighton, Pa., has resigned and contemplates building a plant on the site still to be obtained in the Beaver valley, for the manufacture of brass, bronze and copper castings for blast furnaces and rolling mills, as well as railroad journal bearings.

J. C. Bannister has been elected vice president of the Walworth Mfg. Co., Boston, manufacturer of iron pipe fittings, valves, wrenches, etc. At the time when the Kewanee, Ill., plant of the National Tube Co. was taken over by the Walworth Mfg. Co., Mr. Bannister was manager of this plant and he will continue to maintain his headquarters at Kewanee, no change in the management of that plant being contemplated.

C. E. McArthur, who recently resigned as superintendent of the J. I. Case Threshing Machine Co., Racine, Wis., to accept the position of works manager of the Barnes Foundry & Machine Co., has resigned and has accepted the position of foundry superintendent of the Greenlee Foundry Co., Chicago. The Barnes Foundry & Machine Co., Detroit, which was organized several months ago to engage in the production of automobile castings, has temporarily abandoned its plans owing to unsettled business conditions.

Harrold Hemenway, formerly general superintendent of the plant of the H. W. Cooper Saddlery Hardware Mfg. Co., Moline, Ill., and more recently affiliated with the Stewart-Warner Speedometer Corp., Beloit, Wis., in the capacity of factory manager, recently has become associated with the Peoria Malleable Castings Co., Peoria, Ill. This company, which is capitalized at $175,000, is completing the erection of a malleable iron foundry which will have a capacity of 40 tons daily. The officers of the company follow: L. E. Roby, president; Harrold Hemenway, vice president and general manager; George Ainsworth, secretary; C. A. Pattison, treasurer, and William E. Southerland, foundry foreman.

Death of C. W. Levalley

Christopher W. Levalley, founder of the Chain Belt Co., Milwaukee, and chairman of the board of directors of this corporation, died at his home in that city Friday, Jan. 4. At the close of the civil war he was appointed superintendent of the St. Paul Harvester Co., St. Paul, of which he later became general manager. At this time he recognized the necessity of a positive drive for harvesting machinery and in 1891 he went to Milwaukee where he established the Chain Belt Co. In 1907 he conceived the idea of driving a concrete mixer with a steel chain and using a semi-steel drum. These ideas were incorporated in a chain belt mixer. From 1891 until 1917 he was president and general manager of the Chain Belt Co., latterly having been elected chairman of the board of directors. He also was interested in the C. O. Bartlet & Snow Co., Cleveland, and the Federal Malleable Co., Milwaukee. He was 82 years old.

Molding Facilitated by Use of Special Device

Cope-Handling and Pattern-Drawing Equipment That May be Applied to Any Pneumatic, Crosshead Squeezer Greatly Increases Production

"HERE is a tough job for you, Bill," said Tim Barnes, the order clerk of the Gray Iron Foundry Co. "These orders just came in a bunch and you will notice that not only are they all government work, but they are needed in a hurry."

"Now," grumbled Bill, "all I have to do is to get the castings out. Is that it?"

"Well," said Tim, who made it a point to dodge responsibility, "the boss says it's up to you. He not only has accepted the orders and promised to get them out on time, but he said, 'Now, Tim, you tell Bill that as foundry foreman it is up to him to do his bit for his country by turning out all this stuff as quickly as possible. I'm off for Washington myself, but you tell him to go ahead. If he strikes any snags tell him I'll be back in a few days.' So I guess you're elected, Bill."

Bill was up against a problem that is confronting foundrymen throughout the country. Combined with the worst shortage of labor and materials ever known, the demand for castings is tremendous. The problem of the present is how to increase the output per man. Improvements in old methods are being instituted at plants everywhere and foundrymen are digging in the backs of their heads for dormant ideas which may never have been worked out, but for the urge of war. An idea, prompted by urgent necessity, recently was developed successfully at a foundry in Newark, N. J., into a combined cope-handling and pattern-drawing device which is increasing the output two and threefold over the best records formerly established. The equipment may be attached to any standard air squeezer of the channel head type. The accompanying illustrations show the device applied to an air squeezer producing molds for wheel base castings for stove trucks. These castings weigh 2 pounds each and four are molded in a 13 x 18-inch snap flask. The time consumed in placing the flask and pattern, shoveling and ramming the sand, drawing the pattern and removing the completed mold to the floor is less than two minutes. The application of the cope-handling and pattern-drawing attachment to this job was attended by a marked increase in output. This was due to the difficulty of obtaining a clean draw by hand.

In adapting the job to this method of molding, all that was necessary was to provide the pattern plate and the cope half of the flask with drawing lugs. A typical casting of a larger size produced by this method is a rheostat base weighing 25 pounds, molded in a 21 x 21-inch snap flask. By the use of this attachment, the output of molds from this pattern has been increased to 56 per day per machine, as compared with 22 by the former method. Not only has the output been increased, but a considerable additional economy is effected through the saving of labor. Formerly the production of this mold required the services of a molder and helper. By the improved method, the

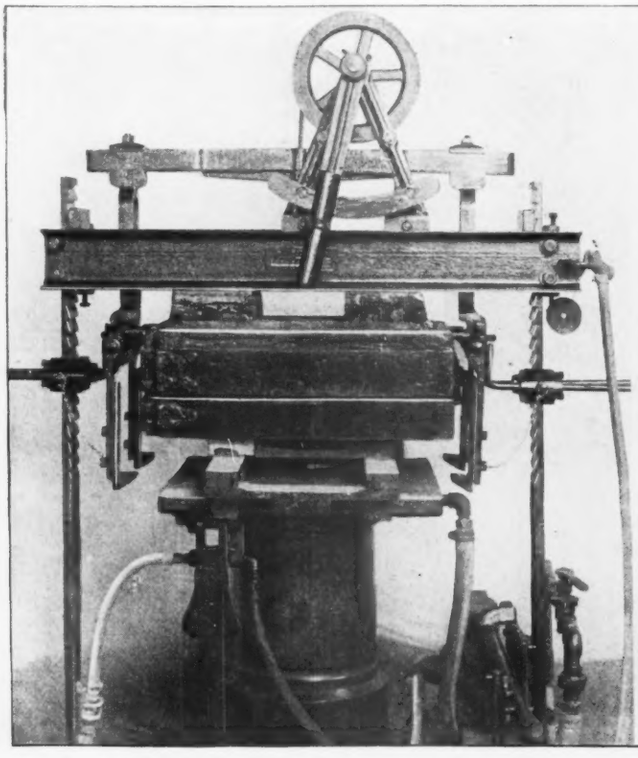


FIG. 1—MOLDING MACHINES EQUIPPED WITH COPE-HANDLING AND PATTERN-DRAWING DEVICE, SHOWING MOLD RAMMED, ELEVATED AND CLAMPED

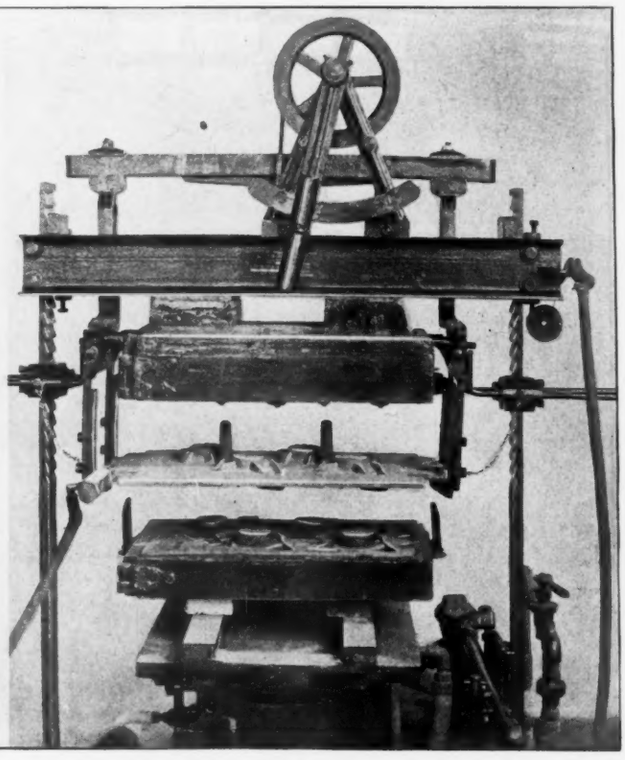


FIG. 2—PATTERN READY FOR REMOVAL AFTER IT HAS BEEN DRAWN BY LOWERING AWAY THE DRAG SHOWING PATTERN DRAWING DEVICE HOLDING THE PATTERN

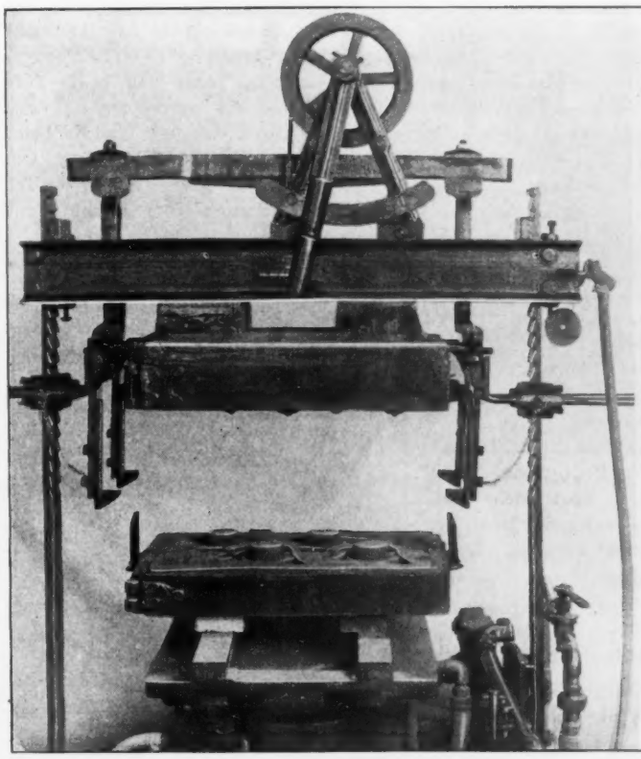


FIG. 3—MOLD READY TO CLOSE AFTER REMOVING THE PATTERN PLATE FROM THE PATTERN DRAWING DEVICE SHOWN IN FIG. 2

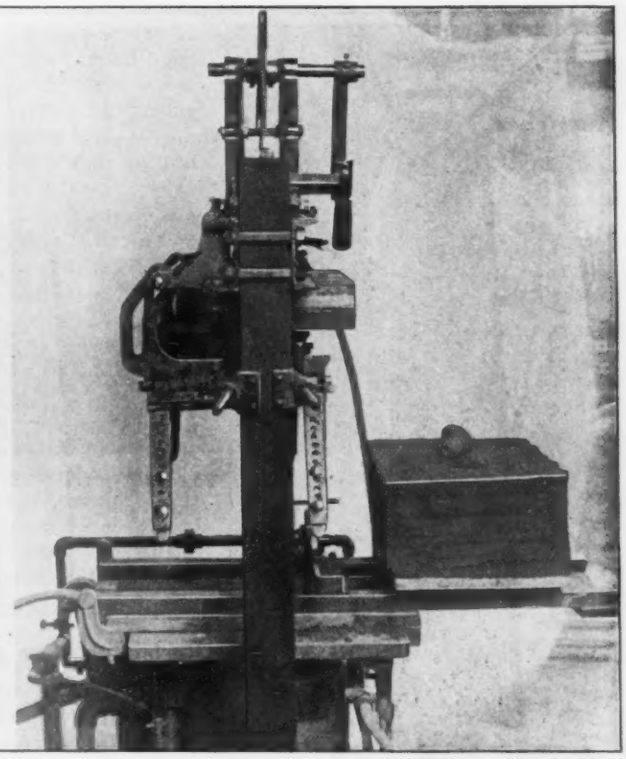


FIG. 4—END VIEW OF MOLDING MACHINE EQUIPPED WITH COPE-HANDLING AND PATTERN-DRAWING DEVICE SHOWING FINISHED MOLD

molder needs help only in removing the mold to the floor, and he and a neighboring molder alternate in performing this service for each other. Aside from the great labor-saving value of the device; it greatly simplifies the task of molding.

In addition to the stove truck wheel base and rheostat base castings, Fig. 5 shows castor wheels and a motor shield casting whose production was increased greatly by the use of the cope-handling and pattern-drawing device. Formerly the castor wheel molds were made by hand as they could not be turned out satisfactorily by molding machines. Since the application of the cope-handling and pattern-drawing device, these molds are being made on molding machines at the rate of 200 per day, compared with a former output of 100. Sixty motor shield molds are being made on a molding machine equipped with the cope-handling and pattern-drawing device as compared with 20 on a machine not so equipped.

The cope-handling and pattern-drawing device may be used with equal success on any type of air squeezer which is provided with a channel head upon which it may be mounted. Vertical bars, equipped with lifting lugs, engage the cope and pattern plate and supporting them while the drag is lowered away from the pattern. The bars are suspended from a cross beam which is raised or lowered by turning a sheave wheel to which the cross beam is attached by a short cable. Supported by housings which rest upon the channel head of the molding machine, the sheave wheel is turned by a lever that swings across a cast iron segment to which it may be locked in any desired position. A suitable guide for each lifting bar effectually prevents the lugs from engaging improperly. Without these guides the cope-handling lugs occasionally might engage the pattern plate, thus causing delay in making the mold. The portion of the lifting bar, which engages the pattern plate, is attached by a hinge and when not in actual use is swung out of the way automatically by means of a chain.

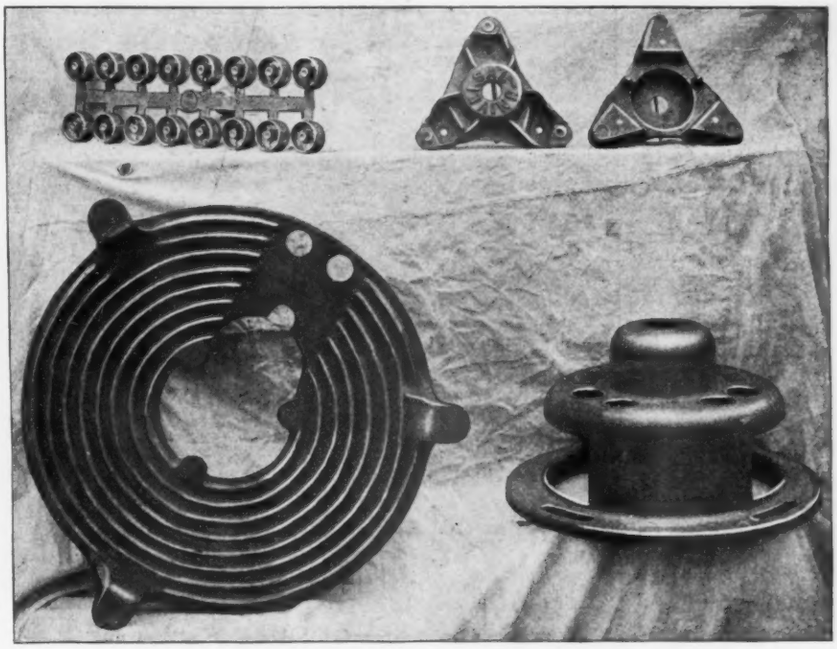
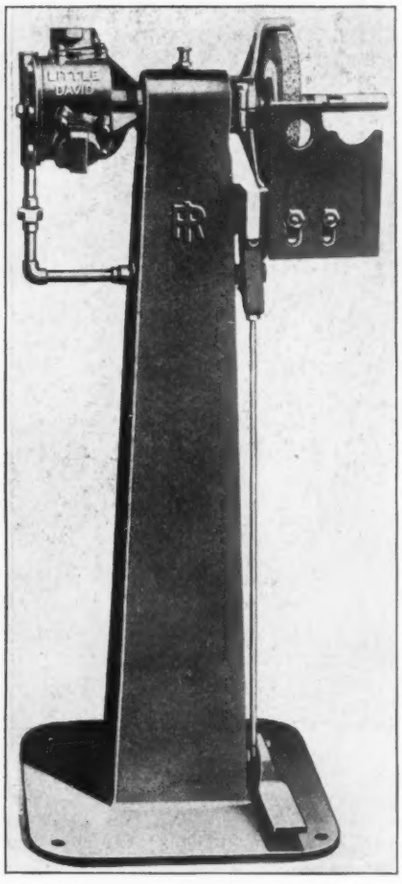


FIG. 5—TYPICAL CASTINGS MOLDED BY AID OF THE COPE-HANDLING AND PATTERN-DRAWING DEVICE. CASTOR WHEELS AND STOVE TRUCK BASES ARE AT THE TOP AND A RHEOSTAT BASE AND MOTOR SHIELD ARE UNDERNEATH



AIR-DRIVEN PEDESTAL GRINDER BUILT BY THE INGERSOLL-RAND CO.

To accommodate flasks of any dimensions within the capacity of the machine, the cross beam has been so designed that the distance between the lifting bars may be regulated at will. An important feature of the device is the automatic adjustment of the cross beam for holding the cope tightly against the head of the molding machine. If the flask rams slightly out of level in molding, due to peculiarities in the shape of the pattern, the cross beam balances itself to compensate for the variation. This feature insures a clean draw under all conditions.

Following a year's successful operation in solving their own molding problems, the designers of this cope-handling and pattern-drawing device have organized the Foundry Appliance Co., Newark, N. J., to build and market it. J. N. Frantz is president and D. B. Diss treasurer of the company.

An Air-Driven Pedestal Grinder

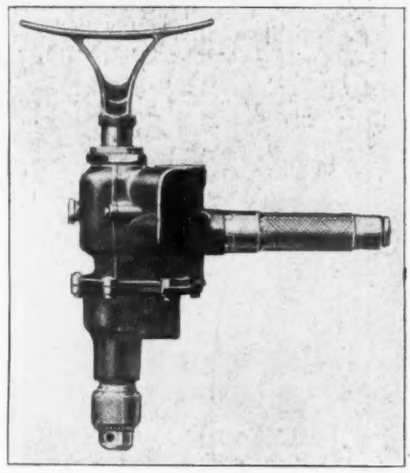
For general service where a stationary pneumatic grinder is preferred to portable equipment, the Ingersoll-Rand Co., New York, has designed a machine shown in the accompanying illustration. The three-cylinder motor with its continuous power impulse, the rotary valve integral with the crankshaft and the triple ball bearing spindle are of a design similar to another grinder built by this manufacturer. The machine is rated to operate at 3400 revolutions per minute with compressed air at 80 pounds pressure. Control is effected by a foot lever and the grinding wheel usually employed is eight inches in diameter and has a 1-inch grinding face.

A 4-page circular has been issued by the Independent Pneumatic Tool Co., Chicago, which illustrates and briefly describes the extensive line of pneumatic tools and electric drills made by this company.

Reclaiming Core and Molding Sand

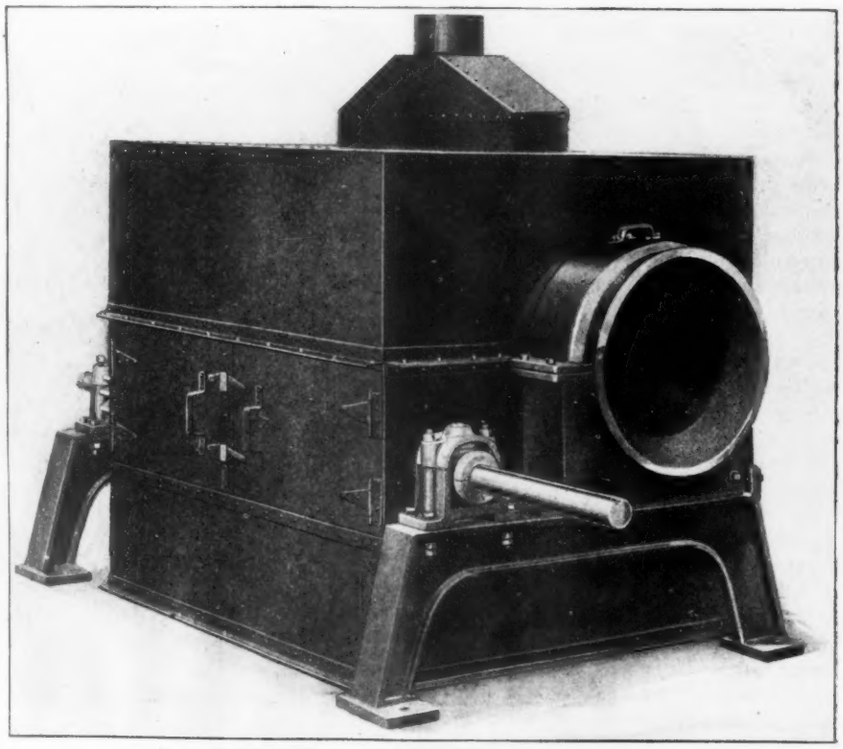
Owing to the embargo by the railroads against furnishing cars for the shipment of foundry refuse, the disposal of this material presents a difficult problem for casting manufacturers to solve. This applies not only to used molding sand, but to burnt cores, etc. That a large part of this sand can be reclaimed by the use of the proper equipment has been proven and great economies may be effected thereby. A considerable percentage of the core sand may be reclaimed, providing the dust and burnt particles are removed.

A mill for crushing cores and separating the metal parts and other residue, shown in the accompanying illustration, has been designed and is being built by the W. W. Sly Mfg. Co., Cleveland. It is made in two sizes, the larger consisting of a crushing mill



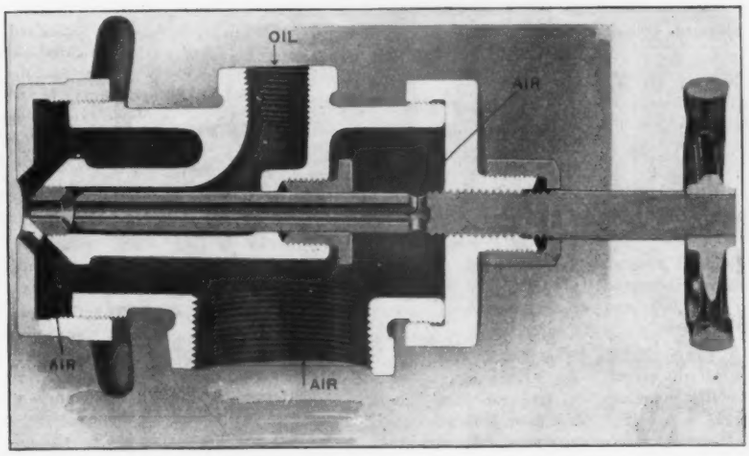
PNEUMATIC DRILL FOR LIGHT WORK, MANUFACTURED BY THE INGERSOLL-RAND CO.

installed near the point where the castings are shaken-out. This crushes the cores and separates metal particles and other refuse from the sand. All fine material, sand and dust is exhausted into a separator placed above the storage bin, in or adjacent to the core room or the core sand mixer. The



MILL FOR RECLAIMING CORE AND MOLDING SANDS, BUILT BY THE W. W. SLY MFG. CO.

separator discharges the reclaimed core sand into a bin by means of a sand valve, while the dust is carried off into the arrester located either inside or outside the bin. The smaller equipment combines the separator with the crushing mill and the dust arrester and fan may be placed to meet local conditions. The crushing mill is not unlike a tumbling mill and is provided with a feed trunnion and a large opening for the continuous charging of the mill with used cores. A crusher grinds all lumps into fine material which passes through the perforations in the mill shell onto a wire screen riddle. The latter is operated automatically by cams on the mill shaft. The mill barrel is provided with a housing which has an opening on one side for discharging wire, nails, etc., from the wire screen riddle. The trunnion and shaft bearings, located outside of the housing, are of the self-aligning type and are supported by heavy, cast iron standards. The fine material which passes through the riddle into the hoper is conveyed into the separator by the suction created by the exhaust fan.



OIL BURNER MANUFACTURED BY THE FOUNDRY EQUIPMENT CO.

A New Drill for Light Work

A high-power, nonreversible drill, especially adapted for reaming up to 5/16 inch and drilling up to 9/16 inch, has been added to the line of pneumatic tools manufactured by the Ingersoll-Rand Co., 11 Broadway, New York. This drill weighs 15 pounds and develops a free spindle speed of 1000 revolutions per minute. Including the drill chuck, its over-all length is 14⅝ inches, the spindle having a length of only 1½ inches, which facilitates operation in corners and contracted areas. The four-piston motor is simple in construction and the convenient accessibility of the reciprocating parts is pointed out as one of its advantages. It is stated that the removal of five cap screws permits the crankshaft assembly to be withdrawn in its entirety. The valve is of the rotary type and is gear-driven. Roller bearings are used on connecting rods and ball bearings on the crankshaft. This drill may be purchased with either breast plate spade handle or telescoping feed screws. In the latter case the length of feed is 2½ inches. The photograph on page 90 shows this drill.

Oil Burner for Foundry Use

In the accompanying illustration is shown an oil burner, in cross-section, which is claimed to be unique in the manner in which the oil is atomized and mixed with the air. The air is delivered from the main air chamber through a hollow brass stem. The oil passes around a circular stream of air and at the end of the brass stem which controls the oil supply the oil is forced into the air stream at a sharp angle. This breaks up the oil into small particles and effects a primary mixing with the air. A second and larger outer stream of air passing through the primary mixture, produces further atomization and provides the proper combination of oil and air for combustion. To remove foreign particles which so frequently cause the clogging of burners of this kind, the handwheel is turned, opening the oil passage full size, thereby removing the obstruction. The amount of oil that may be fed to the burner can be controlled for either a very small or large supply and the air may be similarly regulated. The burner connections provide for a ½-inch oil line and a 2-inch air line giving a wide range of feed for both oil and air. The construction permits access to the mixing valve nozzel.

WHAT THE FOUNDRIES ARE DOING

Activities of the Iron, Steel and Brass Shops

The Lycoming Foundry & Machine Co., Philadelphia, plans to build a new plant.

The Cochrane Brass Foundry Co., York, Pa., will build an addition to its plant.

The Kutztown Foundry & Machine Co., Kutztown, Pa., plans to erect a number of plant additions.

The William Cramp & Sons Ship & Engine Building Co. will erect a brass foundry on Richmond street, Philadelphia.

The Northwestern Malleable Iron Co., Milwaukee, will build and equip a new chipping room.

The Belle City Malleable Iron Co., Racine, Wis., which suffered a severe loss by fire recently, plans to rebuild its foundry at once.

The Anderson Foundry & Machine Works, Anderson, Ind., plans the erection of plant additions to double its capacity.

The A. Buermann Co., 220 Jelliff avenue, Newark, N. J., plans to build an extensive addition to its foundry.

James L. Sparks, 320 West Grand avenue, Chicago, will build a foundry for the manufacture of brass castings.

The Powhatan Brass & Iron Works, Charleston, W. Va., plans to build an addition to its foundry.

The Foundry Metal Works of the Clark Meter Co., Mattoon, Ill., will build a foundry to cost $50,000.

Richard Lau, Buffalo, has secured a site at Marion, O., on which he proposes to build a foundry for making brass, bronze and aluminum castings.

The Singer Mfg. Co., 2215 West Division street, South Bend, Ind., will build a $15,000 addition to its foundry.

The Ada Iron Works, Ada, Okla., will build a foundry for making gray iron and brass castings. William Gilbert is manager.

The Hensley Trolley Mfg. Co., 363 Holden avenue, Detroit, will erect a foundry and machine shop.

The Hay Foundry & Iron Works, Newark, N. J., has had plans prepared for an addition to its plant to cost $7500.

Plans are being prepared for rebuilding the plant of the Southern Wisconsin Foundry Co., Madison, Wis., which was severely damaged by fire in April, 1917.

The Sandusky Foundry & Machine Co., Sandusky, O., has purchased a site adjoining its plant, on which it proposes to build an addition.

The Case Furnace Co., 3002 South Chandler street, Tacoma, Wash., is building a new

foundry to take car of its increased volume of business.

The Frazer & Jones Co., Solvay, N. Y., has laid foundations for a foundry addition to double the capacity of its plant. The company operates a malleable iron foundry.

The Iron City Foundry Co., Hamilton, O., has been incorporated with $50,000 capital and will make gray iron castings. Albert D. Stuckey is in charge.

T. Paulson & Son, Inc., 97 Second avenue, New York, brass founders, have increased their capital from $30,000 to $100,000 and plan to build extensions to their plant.

The Arkansas Foundry Co., Little Rock, Ark., has leased a plant on Sixth street, which it proposes to equip for the manufacture of railroad and mill castings.

A New York syndicate has taken over the plant of the John Davenport Foundry Co., Stamford, Conn., which will be enlarged by the erection of several additions.

The J. A. Clark Foundry Co., Thirty-fifth street and Grays Ferry road, Philadelphia, has had plans prepared for an addition to its plant.

The East Deering Foundry Co., Portland, Me., has been incorporated with $10,000 capital. George R. Thomas, Charles E. Noyes and others are incorporators.

The Midland Electric Steel Co., 565 West Washington boulevard, Chicago, has completed its plant for the manufacture of electric steel castings.

The Hamburg Foundry Co., Hamburg, Pa., has completed the installation of equipment at its new plant. The company will engage in the manufacture of large engine castings.

The Commercial Steel Castings Co., organized recently with $150,000 capital, plans to erect a plant at Marion, O. The company will make electric steel castings.

The Gerlinger Steel Casting Co., West Allis, Wis., is building two additions to its plant and also a track system in its yards. The company manufactures electric steel castings.

The La Point Foundry Co., Schleisingerville, Wis., will install a new furnace in a building which it recently leased. The capacity of the plant will be doubled and the force of bench molders will be increased to 40.

L. E. Roby and C. E. Pattison, Peoria Drill & Seeder Co., Peoria, Ill., are interested in a company which has nearly completed a large malleable iron foundry on Alexander street, Averyville, Ill.

The Enterprise Brass Foundry, 2727 Seventh avenue, Seattle, has installed an oil furnace and a traveling crane to provide increased facilities for the manufacture of ship castings for government contracts.

The Eagle Brass Foundry, Seattle, has recently moved its plant from Railroad avenue and King street to its new plant at 21 Spokane street. The company manufactures ship castings almost exclusively.

The Wind Brass & Aluminum Foundry Co., Cleveland, has been granted a charter of incorporation and will build a plant. The incorporators include L. F. Wind, R. E. Hyde, C. F. Swartzel and others.

The Davis-Durkin Corp., Trenton, Ont. has been chartered to engage in the manufacture of explosives and chemicals and to conduct a foundry and machine shop business. The company is capitalized at $100,000 by Gordon D. Oulster, William Brown and John G. McHattie, Ottawa, Ont.

A charter of incorporation has been granted to Deck Bros., Buffalo, who will operate a foundry and machine shop. The company is capitalized at $35,000 and B. L. Lempenau is in charge.

Woodruff & Edwards, Elgin, Ill., plan to rebuild their foundry and machine shop which was badly damaged by fire recently. Plans are being prepared for a new structure to cost $80,000.

The Gas Traction Foundry Co., Minneapolis, will build a foundry, 195 x 297 feet in size. The cost of the proposed structure will be $75,000. O. W. Potter, 1907 Fourth street, is in charge.

The Rice Lake Improvement association, Rice Lake, Wis., has offered to the Wisconsin Aluminum Foundry Co., Manitowoc, Wis., a free site and further co-operation if the company will re-establish its plant. The offer is under consideration.

The Davis Foundry Co., New Castle, Ind., has been incorporated with $40,000 capital and plans to build a plant. John G. Hey, Louis B. Patterson and William Davis are interested.

The Central City Iron Works, Stevens Point, Wis., has been purchased by the Trenam Tractor Co., Milwaukee, who will continue to operate the plant for the manufacture of gray iron and malleable castings. F. M. Shuler is in charge of the company.

The York Hardware & Brass Co., Wheatfield and Commerce streets, York, Pa., has purchased the plant formerly operated by Billmeyer & Small, which it will equip for the manufacture of bronze and aluminum castings.

The Standard Steel Co., Milwaukee, recently incorporated with $300,000 capital to engage in the manufacture of farm equipment and concrete mixers. The plant will include a foundry, machine shop and assembling plant and will cost approximately $350,000.

The William J. Oliver Plow Co., Knoxville, Tenn., has been incorporated with a capital of $200,000 by S. C. House, H. F. Armstrong, Asa Hazen, Joseph L. Gant and T. A. Wright. The company will manufacture plows and farm implements formerly made by the William J. Oliver Mfg. Co.

The Glauber Brass Mfg. Co., Cleveland, has had plans prepared for a 7-story reinforced concrete manufacturing plant. The cost of the proposed structure will be about $250,000. The foundry will be located on the top floor to supply the maximum of light and ventilation to this department. M. H. Glauber is manager of the company.

The Standard Foundry & Supply Co., Ltd., Walkerville, Ont., recently incorporated with $40,000 capital, has leased the foundry department of the Kerr Engine Co., Walkerville, and is making gray iron castings. The officers of the new company are F. S. Ferguson, president and T. P. Charlton, secretary and treasurer.

H. T. Hornsby, who resigned last July as vice president and general manager of the United Iron Works Co., Springfield, Mo., which position he held for 14 years, has purchased a controlling interest in the Central Foundry Co., Webb City, Mo. J. A. Desbonne, formerly local manager of the United Iron Works Co., Pittsburg, Kans., is associated with Mr. Hornsby.

NEW TRADE PUBLICATIONS

TOOL GRINDING.—An exceedingly valuable and instructive booklet, containing 40 pages devoted to tool grinding, has been issued by the Norton Co., Worcester, Mass. Suggestions are contained therein for making wheel selections, direction of wheel revolution, operations in grinding cutters, clearance grinding grinding side and form cutters, clearance grinding on milling machines, twist drill grinding, regrinding dull taps, grinding lathe and planer tools, with a discussion of hand versus machine grinding and wet versus dry grinding. A number of valuable points to remember in grinding tools also are included, as well as a chapter on die grinding.

INDUSTRIAL PLANT BUCKETS. — An exceedingly well-arranged, well-illustrated and artistic catalog, containing 26 pages, devoted to buckets for industrial plants, has been published by the Hayward Co., 50 Church street, New York. These buckets are of the two-line, clamshell type, for use on cranes or derricks having a double drum hoist, and also an electric motor bucket which may be hung onto or taken from the hook of any crane or other hoisting machine without the loss of time. With the latter type of bucket no opening or closing lines are required since the jaws of the bucket are operated by an electric motor which is integral with the bucket itself. The absence of opening and closing line make it possible to operate this bucket where overhead room is limited. Many installation views are included, showing these buckets in use at coal storage plants, handling sand in foundries, coke in storage yards, conveying coal to boiler rooms, handling refuse in industrial plants, etc. Numerous blue print illustrations also are included, showing clearly the details of the various installations.

MOLDING MACHINES. — An unusually well-arranged and artistic catalog, containing 110 pages, devoted to its extensive line of molding machines, has been issued by the International Molding Machine Co., Chicago. Because of the large number of views of machines under actual operating conditions this work should prove of added interest to foundrymen generally. The lines of machines built by this company include 18 different types, all designed for a single general purpose yet each one differing widely in construction and method of operation. Suggestions and comments for the prospective purchaser of molding machines should prove of great value to foundrymen and by pursuing these recommendations many errors in the installation of mechanical molding equipment will be obviated. The catalog is divided into sections, devoted to each type of machines as follows: Turn-over draw, power turn-over power draw, combination jar-ramming turn-over draw, combination jar-ramming power turn-over foot draw, combination jar-ramming power turn-over power draw, plain turn-over, combination jolt-stripping, combination jolt squeezer stripping, air jarring, electric jarring, power squeezer, combination jolt squeezer, combination stripping squeezer and stripping plate machines. A fund of information is contained in this work with reference to the mounting of patterns and every detail of the operation of these machines is described and illustrated by line drawings.